# City of Corvallis

# Salmon Response Plan

Prepared for:

**City of Corvallis, Oregon**
**Public Works Department**
PO Box 1083
Corvallis OR 97339-1083

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Prepared by:


Bill Jones, Ph.D.
Robert Dillinger, Ph.D.
**Natural Resource Planning Services, Inc.**
3030 SW Moody Avenue, Suite 105
Portland, Oregon 97201
503.222.5005

# PROJECT TEAM

## CITY OF CORVALLIS MANAGEMENT TEAM

- Tom Penpraze – Project Manager (Utility Division Manager)
- Greg Gescher, P.E. -- Deputy Project Manager (Capital Planning and Projects Supervisor)

## TECHNICAL ADVISORY COMMITTEE MEMBERS

- Diana Sharps -- Corvallis Public Works Department Water Resources Specialist
- Fred Towne – Corvallis Community Development Department Planner
- Greg Verret - Benton County Senior Planner
- Jackie Rochefort - Corvallis Parks and Recreation Department Planner
- Jim Mitchell - Corvallis Transportation Division Manager
- Joe Whinnery -- Corvallis Parks and Recreation Department Operations Supervisor
- Rick Lee - Corvallis Transportation Division Street Supervisor
- Steve DeGhetto -- Corvallis Parks and Recreation Department Operations and Maintenance Supervisor

## CONSULTANT TEAM

### Natural Resource Planning Services, Inc.

- Bill Jones, Ph.D. – Project Manager
- Rob Dillinger, Ph.D. – Principal-in-charge
- Mike Wallace – Staff Biologist
- Lee Burleson – Technical Editor

### Alsea Geospatial, Inc.

- John Gabriel – GIS Task Manager
- Rachel Schwindt – GIS Staff

### Cogan Owens Cogan

- Kirstin Greene, AICP – Public Involvement Task Manager
- Damian Pitt -- Public Involvement Staff

### TetraTech/KCM, Inc.

- Brad Moore, P.E. – Engineer Task Manager
- Jim Harper, P.E. -- Engineer Staff

## DISCLAIMER

The authors have attempted to replace all references to Squaw Creek with the creek's new name, Dunawi Creek. This includes replacing the creek's full name as well as changing Squaw Creek Reach reference labels to indicate Dunawi Creek.

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# EXECUTIVE SUMMARY

## INTRODUCTION

The City initiated the Salmon Response Plan project during the summer of 2000. The plan was to comply with protection regulations surrounding the listing of Upper Willamette River Spring-run chinook salmon as a threatened species under the Endangered Species Act (ESA) in March 1999 (Federal Register, Vol. 64, No. 56, page 14308-14328, March 24, 1999). At that time, the National Marine Fisheries Service (NOAA Fisheries) identified the range or geographic distribution for the Upper Willamette River Spring-run chinook salmon evolutionarily significant unit (ESU; Figure ES1 for a map of the ESU). Jurisdictions located within the ESU, which included the City of Corvallis, would from that date forward be held responsible for preventing any further degradation of chinook salmon habitat.

The purpose of the Salmon Response Plan project was to identify activities (both City of Corvallis sponsored as well as Corvallis citizen behaviors) that negatively impact chinook salmon habitat in Corvallis and develop a plan to, at a minimum, prevent further degradation. Additionally, where chinook salmon habitat existed in city creeks and rivers the City also identified long-term activities that lead toward restoration of properly functioning conditions (PFC) to support chinook salmon.

### Controlling Federal Regulation

The federal government since 1973, the year that the ESA was passed, had the authority to identify and impose protections for specific species (wildlife, fish, and plants) in order to prevent these species from becoming extinction. The ESA set out guidelines for listing species, levels of protection depending on whether a species was listed as endangered of or threatened with becoming extinct, any special exceptions to the protections, penalties for violating the protection guidelines, and guidelines for de-listing a species should it no longer be endangered or threatened with extinction.

In July 2000, NOAA Fisheries, the federal agency with regulatory authority for marine species including anadromous fish, published final ESA Section 4(d) Rules for protection of listed salmonids in the northwestern United States (including Upper Willamette Spring Chinook Salmon). Importantly, the ESA Section 4(d) Rules allowed incidental take of listed anadromous fish as long as the jurisdiction could ensure that, overall, it did not jeopardize the listed species from becoming either endangered or extinct. These rules, developed specifically for listed northwestern salmonids, provided options for jurisdictions to obtain an incidental take permit from NOAA Fisheries for its activities. This permit ensured compliance with the ESA and provided protection in the event of legal challenges by the federal government and/or other parties.

**Figure ES1. Chinook Salmon Evolutionarily Significant Unit (ESU) Map**

*See separate file*

## Project Rationale

The City embarked upon this effort for two reasons. First, the City administration (elected officials) and its residents believed they had a responsibility to help maintain the natural environmental processes critical to the environmental health and quality of life in the Willamette River Valley and state of Oregon. This responsibility had been reflected in many of the City's previous and ongoing activities; from the preservation of open space and natural resources, reduction of stormwater run-off and contamination of local streams, preservation of the Willamette River waterfront, participation in other environmental planning efforts (e.g., State-wide Goal 5 Significant and Natural Features Inventory projects), to the high degree of citizen participation in the city's recycling programs. Participation in the preservation of chinook salmon habitat was consistent with the City's position and ethic to take actions that contributed to overall environmental and community health.

Second, the City administration had a fiduciary responsibility to its residents to protect their interests through responsible decision-making and actions. Such decisions applied to the ESA listing of chinook salmon where the City had compared the costs and benefits of complying with federal rules and the protections that compliance offered to the potential risks, liabilities and costs of non-compliance. The City determined that compliance with the federal rules governing chinook salmon habitat, specifically the ESA Section 4(d) Rules, to be more beneficial than potentially costly third-party law suits challenging the City to demonstrate compliance with these federal rules.

## PROJECT STRUCTURE

The City budgeted a multi-year project to develop a Salmon Response Plan. The Plan would assess chinook salmon habitat in streams within the City limits and the area within the unincorporated urban growth boundary (UGB), and develop a response plan based on sound science that would 1) prevent further chinook salmon habitat degradation and 2) eventually put the habitat on a trajectory toward PFC (see project area map in Figure ES2). The City hired a team of consultants with expertise in the ESA, chinook salmon biology and ecology, and the recently implemented ESA Section 4(d) Rules.

While the project was unique in its methodology by using a scientific approach to define, identify, evaluate and protect chinook salmon habitat, it incorporated previous City, regional, and statewide efforts to protect natural resources, water quality, and salmon. Such an approach helped to keep project costs down and provided the project team with useful data, reports, and programs that could be integrated and expanded in the Salmon Response Plan. Among the relevant activities that were incorporated into the Salmon Response Plan was the City's comprehensive stormwater master planning effort and the Goal 5 (Significant Natural Features) planning. Region and statewide programs such as the "Oregon Plan for Salmon and Watersheds" and the Willamette Restoration Initiative (WRI) were also helpful.

**Figure ES2. Corvallis Salmon Response Plan Project Area**

*See separate file*

## Project Team

The Project Team was made up of three levels – City project management, technical advisory committee, and the technical consultants. Tom Penpraze was the City's overall project manager. Greg Gescher, P.E., supported him. A technical advisory committee (TAC) made up of City staff representatives from across City departments (utilities, transportation, community planning, parks and recreation) and a Benton County planning department representative was appointed to help guide and consulting team and review and comment on the project materials that were prepared by the project team. Professional consultants with expertise in biology, watershed ecology, fisheries science, planning, regulatory compliance, economics, geographic information systems and mapping, and public involvement were hired to manage the day-to-day project activities. Drs. Robert Dillinger and Bill Jones managed the project team from the project's inception to completion.

Two other groups played a significant role in the project and helped guide the final project results. The public (direct stakeholders and public at large) played an important role in the project. Project team communication with the public to inform, educate, and take comment on the type of program that they would support was initiated early and continued throughout the project. Meetings, workshops, news articles, fact sheets, direct contact, questionnaires/comment sheets, and web site communication were the methods the project team used to keep the public involved.

A second important group was NOAA Fisheries, the responsible federal regulating agency. Communication began during the project's early stages to ensure that the City received the benefit of guidance from the Agency that would ultimately receive the City's report and certify compliance under ESA Section 4 (d). Frequent communication continued throughout the entire project.

## Two-Phase Study and Key Tasks

The project had two phases. Phase One of the project developed a comprehensive environmental baseline documenting the existing conditions of city streams for chinook salmon habitat. A pathways/effects analysis assessed the impact of City activities and citizen behavior on chinook salmon habitat.

Phase Two used the pathways/effects analysis to determine the degree and geographic distribution of City activities and citizen behavior that negatively impacted habitat. Activities were weighted and ranked according to their impact in order to identify solution options to prevent further habitat degradation and eventually restore PFC. The solution options included activities and programs that were currently implemented or being initiated under different programs as well as new activities. Importantly, the options identified were from across nearly all City departments.

This project would support the final preparation and submission of an ESA Section 4(d) Rule Limit 12 (Municipal, Residential, Commercial, and Industrial Development Program) application to NOAA Fisheries. The application would document the City's understanding of chinook salmon habitat, City activity and citizen behavior impacts, and solutions that would be implemented to meet ESA requirements.

To accomplish this project the following key tasks were completed:

- Development of an existing conditions database (existing sources and field data collection).

- Production of a geographic information systems (GIS) map of city streams with a 400-foot riparian corridor evaluation area (200 feet on each side of the top of bank).

- Creation of a pathways/effects evaluation of City activities (e.g., public infrastructure and services, transportation, operations and maintenance activities, parks and recreation, land use planning etc.) and citizen behavior (e.g., household activities, yard maintenance, home auto repairs, etc.).

- Preparation and submittal of the Phase One report "Baseline Habitat Evaluation and Evaluation of Impacts of City Activities" to NOAA Fisheries (approved by NOAA Fisheries in January 2002).

- Development of a database of weighted data that compared the pathways/effects analysis of City activities and citizen behavior against the baseline conditions database to determine the degree of chinook salmon habitat impact and its distribution.

- Development of solution options to prevent further degradation of chinook salmon habitat.

- Development of solution options to put the City on a trajectory toward achieving PFC in its streams and rivers.

- Development of a monitoring program.

- Preparation of a final report combining both phases of the project into a single report in partial fulfillment of the requirements for submission to NOAA Fisheries.

- Provide extensive public involvement activities throughout the project (stakeholder and open house meetings, press releases, comment forms, project website, etc.) to ensure public understanding of the project and to provide the general public with an opportunity for input.

## ACCOMPLISHMENTS

This project took steps to identify and document baseline habitat conditions for chinook salmon and the options available to prevent chinook salmon habitat degradation as well as options that could actually improve such habitat and overall water quality in Corvallis streams. Many of these options have, in fact, been initiated. Through this process the City has also made a substantial effort to meet federal compliance requirements under the ESA, specifically with respect to the ESA Section 4(d) Rule. The results of this effort are briefly described below.

- <u>Scientific understanding of existing conditions</u>: a scientifically based evaluation has been conducted that provides the City with detailed and comprehensive picture of chinook salmon habitat and water quality in the city as well as the unincorporated UGB. The scientific approach was approved and, in fact, lauded by NOAA Fisheries, the federal agency responsible for reviewing all compliance plans for the ESA Section 4(d) Rule. An extensive database was prepared on the existing habitat conditions based upon field data collection and evaluation of existing documentation (sources included the Corvallis, Oregon State University [OSU], and state and federal natural resource agencies). The database provided information on a reach-by-reach basis for all streams that could support chinook salmon habitat in the project area (see Figure ES3 for a map of all the stream reaches evaluated).

- <u>Pathways database</u>: The potential relationship between City activities, citizen behavior and their impact on chinook salmon habitat were analyzed. Public services provided by the City (e.g., public utilities, community planning, land development, transportation, parks and recreation, etc.) and citizen behaviors (e.g., yard maintenance, vegetation, vehicle maintenance, etc.) were evaluated as to their impact on the habitat. A database identifying specific City activities and their relationship to chinook salmon habitat (negative, neutral, or beneficial relationship) was prepared. Similarly, a list of citizen behaviors was prepared that noted whether such activity had a potential negative, neutral, or beneficial relationship on the habitat.

- <u>Phase I Report</u>: The first phase of the project ended with preparation of a report on the City's existing or baseline habitat conditions and the pathways analysis (see Appendix 6). This was submitted to NOAA Fisheries after public input from stakeholders and city residents in special stakeholder meetings and a public workshop. NOAA Fisheries review and response was positive. In a letter to the City (January 7, 2002) they approved the baseline conditions evaluation and pathways analysis and considered it a "thorough compilation of existing and new data" and the pathways analysis showing "the list of activities and potential for impact to fish and habitat appears thorough and thoughtful." Most importantly, the letter stated that "the approach and the baseline data collected will be sufficient for us to determine the technical adequacy of the final 4(d) submittal" (see Appendix 7 for copy of letter).

**Figure ES3. Stream Reaches with 400-foot Stream Corridor Evaluation Area Identified**

*See separate file*

- Pathways Weighted Database: A comprehensive database that combined the existing/baseline conditions data with the pathways evaluation data was prepared in the second phase of the project. This was a significant development and important tool for the project because it identified the potential impacts (negative, neutral, or positive) that City activities and citizen behaviors had on chinook salmon habitat on a stream reach by reach basis. That is, it was possible to determine specifically where (i.e., what stream reach or reaches) and to what extent (negative, neutral, positive) a particular activity had on chinook salmon habitat and water quality in the stream reach(es) (see Appendix 5 for a CD of the database). In addition, the analysis incorporated a weighting factor that accounted for an activity's geographic location within or outside of the 400-foot stream corridor evaluation area (200 feet upland each side of the stream bank). Activities or citizen behaviors occurring within the corridor were considered to have a greater impact on chinook salmon habitat than those same activities or citizen behaviors occurring outside the corridor. Due to the number of City activity/stream reach combinations the size of the Pathways Weighted Database included over 3,500 records.

- Potential 4(d) Rule Options: By using the Pathways Weighted Database as an analytic tool it was possible to determine the geographic distribution and impact of City activities. From this database it was possible to determine which activities had the greatest negative impact and therefore potentially the greatest need to address through public policies. The project team evaluated the activities and identified an initial set of potential 4(d) Rule Limit 12 options that could help prevent chinook salmon habitat degradation and improve water quality in Corvallis streams. The options were categorized by City activity (e.g., stormwater, parks and recreation, transportation, etc.). Some of the options identified had already or were about to be implemented by City agencies (e.g., stormwater master plan activities, Taylor pump station fish screen installation, etc.). They were included in the list of options because they would help meet the City's ESA goals and ESA 4(d) Rule objectives. The options were presented to the public twice in public workshops to obtain public comment to help refine the options and set priorities. In addition, comment forms were distributed and posted on the City's ESA web site to gain as wide a set of comments as possible (see Appendices 14 and 15 for copies of the comment forms). A final set of options was developed based on public input and project team review (see Table ES1 at the end of this section for a list of the options that were selected).

- Monitoring Plan: In order to assess progress toward reducing chinook salmon habitat degradation and to meet requirements under the ESA Section 4(d) Rule, the project team prepared a comprehensive monitoring plan. The monitoring program closely followed the requirements outlined in the ESA 4(d) Rule. The monitoring plan would allow the City to assess progress toward meeting its habitat goals and compliance requirements. The plan had scientific and programmatic components. The programmatic component would evaluate the programs and program implementation outlined in the ESA 4(d) Rule Plan. It would focus on overall program development and implementation that will take place during the life of the plan. The scientific component addressed specific protocols for collecting field data comparing the data against a standard or metric to determine progress. Combined, the monitoring plan would provide the City and NOAA Fisheries a method to track plan progress and effectiveness.

- Final Project Report: A final Salmon Response Plan Report was prepared that incorporated all the project team's work and products. This report outlined what had been accomplished and provided a strong base on which to move forward toward implementing the proposed options and preparing the ESA Section 4(d) Rule report to be submitted to NOAA Fisheries for compliance approval.

## FUTURE STEPS

Before the City can submit its formal ESA 4(d) Rule plan to NOAA Fisheries the report identified key activities that need to be addressed. The following are a list of these key activities.

- Select and Implement ESA Options: the City Council will need to formally adopt the proposed ESA 4(d) Rule options identified in this report. NOAA Fisheries requires that the ESA program be implemented to demonstrate that it is complying with the ESA 4(d) Rule. A number of the options are already being implemented as part of other programs, but there are options that cannot be implemented until they are adopted by the City Council. Once formally adopted, the City will need to outline an implementation schedule and initiate implementation for those options that are note already underway.

- Initiate the Monitoring Program: the monitoring program will need to be activated to provide the feedback support necessary to assess program effectiveness.

- Land Development Code Update: the City is in the process of updating its land development code (LDC) to incorporate a number of environmentally sound programs and policies into its development standards. The Stormwater Master Plan, results of the Significant Natural Features (Goal 5) Project and the ESA Salmon Response Plan need to be incorporated into the LDC. By doing so the City can certify that relevant options have been incorporated into the land development standards.

- Comprehensive Plan Update: it will be important for the City to incorporate relevant elements into the City's comprehensive plan. A number of the identified options are related to City planning policies and zoning. While comprehensive planning revisions do not have to be completed, a process should be outlined or underway that the 4(d) Rule report can identify.

- Integration of ESA Plan and data, Stormwater Master Plan, and Significant Natural Features (Goal 5) data: there are two other related projects that should be integrated with the ESA Salmon Response Plan. While they may have been initiated under different authorities, they are related because they address water quality and natural resource features that the ESA program identifies as important for preserving and improving chinook salmon habitat. While there are a number of good reasons why they should be integrated, from the ESA 4(d) Rule program standpoint integration will demonstrate to NOAA Fisheries that the City is taking a comprehensive approach, which will increase the likelihood of success.

- National Environmental Policy Act (NEPA): according to NOAA Fisheries an environmental impact analysis will need to be prepared to accompany the ESA 4(d) Rule Plan submission. It is unclear at this point whether the environmental impact analysis will have to be prepared by the submitting jurisdiction (Corvallis) or by the federal agency. City staff and consultants met with NOAA Fisheries officials in late Fall 2002 and Spring 2003 to discuss the environmental documentation requirement. At that time NOAA Fisheries was considering the preparation of a programmatic environmental impact statement (EIS) that would address the ESA 4(d) Rule Limit 12 that Corvallis was to submit. NOAA Fisheries could not provide a completion date because they had not yet scheduled the EIS work. One option that NOAA Fisheries suggested was that the City could prepare the EIS on its own and submit it with the ESA 4(d) Rule. The environmental documentation would take the City some time and expense to prepare. As of the date of this report, the City has not decided whether they will prepare it.

- Prepare ESA 4(d) Report: Once the above key steps are completed the City will need to submit the ESA 4(d) Rule Report to NOAA Fisheries. The report must address how the City's program will meet each of the 12 limits outlined in the ESA 4(d) Rule Limit 12 (Municipal Commercial Residential Industrial or MRCI) development program. It will be important to demonstrate that all the programs combined satisfy all 12 limits.

These are the key future steps that will need to be taken to meet the City's goals and comply with the ESA 4(d) Rule. They will build on the foundation that has been prepared up to this point.

**Table ES1. Considerations and Solution Options Matrix**

| Solution Option | LIMIT 12 CONSIDERATIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value) | Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed. | Protects riparian areas well enough to attain or maintain PFC | Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible. | Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines | Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands. | Adequately preserves permanent & intermittent streams' ability to pass peak flows. | Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer. | Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies. | Ensures demands on water supply can be met without affecting the flows that threatened salmonids need. | Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs. | Complies with all other state & Federal environmental & natural resource laws & permits. |
| **Land Use** | | | | | | | | | | | | |
| Zoning | X | X | X | X | X | X | X | X | X | X | X | X |
| Development Standards | X | X | X | X | X | X | X | X | X | X | X | X |
| **Park & Recreation** | | | | | | | | | | | | |
| Neighborhood Park Planning | X | X | X | X | X | X | X | X | X | X | X | X |
| Open Space & Recreation Service Plan | X | X | X | X | X | X | X | X | X | X | X | X |

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| Capital Improvement Plan | X | X | X | X | X | X | X | X | X | X | X | X |
| Park O&M Manual | | X | X | | | X | | X | X | | X | X |
| Park Inventory | X | X | X | X | X | X | X | X | X | X | X | X |
| Existing Parks | | X | X | | | X | | X | | | X | X |
| Park Construction Retrofit | X | X | X | X | | | | X | X | X | X | X |
| Mini Parks | X | X | X | X | X | X | X | X | X | X | X | X |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Specific Parks | X | X | X | | | X | | X | X | X | | X |
| Equipment Maintenance | | X | | | | | | | | | | X |
| Organic Debris Disposal | | X | | | | X | | | X | | X | X |
| **Construction Specifications** | | | | | | | | X | | | | |
| On-site Construction Activities | | X | X | | | X | | | X | | X | X |

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| Construction Site Enforcement | | | X | | | X | | | X | | X | X |
| Hazardous Materials | | X | | | | | | | X | | | X |
| Pipe Commissioning | | X | | | | | | | X | | | X |
| Erosion Control Ordinance | | X | X | | X | X | X | | X | | X | X |
| Sustainability | X | X | X | X | X | X | X | X | X | X | X | X |

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| **Transportation**<br>Planning Elements | X | X | X | X | X | X | X | X | X | X | X | X |
| TDM | | | X | X | | X | | | | | X | X |
| Transportation System Plan | X | X | X | X | X | X | X | X | X | X | X | X |
| CIP | X | X | X | X | X | X | X | X | X | | | X |
| Design Specifications | | X | | | | X | | X | X | | | X |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Routine Rd. Maintenance - ESA Limit 10 | | X | | X | | X | | | X | | X | X |
| **Stormwater**<br>Planning & CIP | X | X | X | X | X | X | X | X | X | X | X | X |
| Erosion Control Ordinance | | X | X | | X | X | X | | X | | X | X |
| O&M | | X | X | | | X | | X | X | | | X |
| Monitoring | | | | | | | | | | | X | X |

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| Solution Option | LIMIT 12 CONSIDERATIONS 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value) | Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed. | Protects riparian areas well enough to attain or maintain PFC | Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible. | Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines | Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands. | Adequately preserves permanent & intermittent streams' ability to pass peak flows. | Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer. | Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies. | Ensures demands on water supply can be met without affecting the flows that threatened salmonids need. | Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs. | Complies with all other state & Federal environmental & natural resource laws & permits. |
| **Wastewater**<br>Wastewater Treatment | | | | | | | | | | | X | X |
| Facility Oils & Grease Program | | | | | | | | | | | X | X |
| Wastewater Collection, | X | | | X | | X | | | X | | X | X |
| O&M | | | | | | X | | | X | | X | X |
| Master Plan and CIP | X | X | X | X | X | X | X | X | X | X | X | X |

**Table ES1. Considerations and Solution Options Matrix**

| | LIMIT 12 CONSIDERATIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **Solution Option** | Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value) | Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed. | Protects riparian areas well enough to attain or maintain PFC | Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible. | Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines | Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands. | Adequately preserves permanent & intermittent streams' ability to pass peak flows. | Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer. | Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies. | Ensures demands on water supply can be met without affecting the flows that threatened salmonids need. | Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs. | Complies with all other state & Federal environmental & natural resource laws & permits. |
| Discharge | | | | | | X | | | | | X | X |
| **Water**<br><br>Water Supply Conservation | | | | | | | | X | | X | X | X |
| Water Intake | | | | | | | | | | X | X | X |
| Distribution | X | | | X | | X | | | X | X | X | X |
| O&M | | | | | | X | | | X | | X | X |

**Table ES1. Considerations and Solution Options Matrix**

| Solution Option | LIMIT 12 CONSIDERATIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value) | Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed. | Protects riparian areas well enough to attain or maintain PFC | Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible. | Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines | Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands. | Adequately preserves permanent & intermittent streams' ability to pass peak flows. | Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer. | Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies. | Ensures demands on water supply can be met without affecting the flows that threatened salmonids need. | Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs. | Complies with all other state & Federal environmental & natural resource laws & permits. |
| **Citizen Behavior**<br><br>Public Education Involvement | X | X | X | X | X | X | X | X | X | X | | |
| Incentives | | X | X | | | X | | X | | X | | |
| Pollution Prevention | X | X | X | | X | X | X | X | X | X | X | X |
| Landscaping | | | X | | X | X | X | X | | X | | |

**Table ES1. Considerations and Solution Options Matrix**

| Solution Option | LIMIT 12 CONSIDERATIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value) | Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed. | Protects riparian areas well enough to attain or maintain PFC | Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible. | Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines | Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands. | Adequately preserves permanent & intermittent streams' ability to pass peak flows. | Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer. | Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies. | Ensures demands on water supply can be met without affecting the flows that threatened salmonids need. | Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs. | Complies with all other state & Federal environmental & natural resource laws & permits. |
| Household | | X | X | | | | | X | X | X | | X |
| Vehicle Maintenance | | X | X | | | | | | | | | X |
| Riparian Areas | | X | X | | X | X | X | X | X | X | | X |

# CHAPTER 1. INTRODUCTION

## REPORT ORGANIZATION

This report outlines the regulatory compliance requirements, project history, and technical, policy, and public involvement work that the City of Corvallis, Oregon has undertaken to craft a response to the Endangered Species Act (ESA) listing of chinook salmon as threatened in the Upper Willamette River. Each chapter addresses a specific topic in the development of the City's ESA Salmon Listing Response Plan (Salmon Response Plan).

### Brief Chapter Descriptions

Chapter I (Introduction) is a project overview. It briefly covers the project purpose, the ESA listed species, federal compliance requirements, the City's rationale for pursuing the ESA 4(d) Rule, project development history, and key tasks undertaken to develop the Salmon Response Plan.

Chapter II (ESA and Section 4(d) Rule Requirements) addresses the ESA. It provides a brief history of the ESA, the listing process, enforcement, and compliance options available to local agencies that have listed species within their jurisdiction. Chapter II also contains a detailed discussion of the 4(d) Rule and the guidance it provides for listed salmonids such as chinook salmon.

Chapter III (Project Structure) provides background information on the project. It outlines the City's demographics, project area, other related projects, and a brief history of the City's effort to prepare the Salmon Response Plan. Chapter III also describes the project structure used to prepare the Salmon Response Plan (e.g., two-phased approach, federal oversight, partnership with Benton County, the consultant team, local technical oversight and role of the public).

Chapter IV (Methodology) focuses on the methodology used to prepare the City's baseline salmon habitat conditions including the literature review, fieldwork and data collection process and analysis. It emphasizes the scientific rigor for determining existing conditions on which the Salmon Response Plan is based.

Chapter V (Baseline Conditions) addresses the baseline conditions and findings. It describes the development of the baseline conditions database that covers all streams and rivers in the project area. General descriptions of the existing conditions are provided for the reaches within the project area. The key findings focus on the historic and existing chinook salmon habitat in the project area.

Chapter VI (Pathways/Effects Analysis) focuses on the analysis of City activities and citizen behavior and how they influence chinook habitat. This chapter describes how existing City activities (planning, land development code, public infrastructure, transportation, parks and recreation, maintenance and operation, etc.) and citizen behavior (yard maintenance, recycling, etc.) impact the existing chinook salmon habitat conditions. This is the most critical step in the project because it allows the City to identify activities that impact (positively and negatively) existing habitat as well as the degree and spatial distribution of the impact. The City has created a unique weighted pathways database to perform this work and analysis. The results of this analysis give the City the ability to rank activities according to their impact, setting the stage for developing solution options for those activities that have the greatest negative impact.

Chapter VII (Proposed Limit 12 Program Solutions) presents the proposed solution options based on the analysis in Chapter VI. Chapter VII contains extensive discussion on the development of the solution options as a product of the pathways/effects analysis and input from the Technical Advisory Committee (TAC), stakeholders, and general public (public meetings, surveys, comment forms). The solution options are identified and described.

Chapter VIII (Monitoring/Reporting) focuses on the proposed monitoring that will be performed to assess progress toward meeting the project goals of achieving properly functioning conditions (PFC). The monitoring will cover both the technical/scientific monitoring (field data collection, testing and analysis) and programmatic monitoring (how well the proposed options and programs are accomplishing the project goals).

Chapter IX (Public Involvement) describes the extensive public involvement used throughout the project. The project has relied on a multi-media approach including stakeholder and citizen meetings, news releases, e-mail announcements, fact-sheets, comment forms, and a special website devoted to the project.

Chapter X (Conclusion: Next Steps and Future Directions) contains a discussion of what the City will do to prepare a formal application for the ESA Section 4(d) Rule submission to the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries). This discussion includes a schedule of other City activities that must be accomplished before the NOAA Fisheries application can be submitted.

Supporting materials are included. A Glossary and Bibliography are provided to define terms and identify source materials used throughout the project. An appendix of key reports, technical memoranda, and public education documents also is included. Finally, an electronic copy (compact disk) of the pathways database is provided. The database contains the weighting scores used to determine the relative impact City activities have on chinook salmon habitat in Corvallis.

## PROJECT PURPOSE

The City initiated the Salmon Response Plan project during the summer of 2000. The plan was to comply with protection regulations surrounding the listing of chinook salmon as a threatened species under the ESA (March 1999). At that time, the range for the Upper Willamette River Spring Chinook Salmon evolutionary significant unit (ESU) was identified by NOAA Fisheries. The City is located within the range of the ESU (Figure 1). From that date forward local jurisdictions were held responsible for preventing further degradation of chinook salmon habitat.

## Figure 1. Chinook Salmon Evolutionarily Significant Unit (ESU) Map

*See separate file*

The purpose of the project is to identify activities (both City and citizen) that have negative impacts on chinook salmon habitat and develop a plan to, at a minimum, prevent further degradation. The long-term goal of the project is to implement activities that put fish habitat in city creeks and rivers on a trajectory toward PFC.

### Project Rationale

The City has embarked upon this effort for two reasons. First, the City administration (elected officials) and its residents believe they have a responsibility to help maintain the natural environmental processes critical to the environmental health and quality of life in the Willamette River Valley and state of Oregon. This responsibility is reflected in many of the City's previous and ongoing activities; from the preservation of open space and natural resources, reduction of stormwater run-off and contamination of local streams, preservation of the Willamette River waterfront, participation in other environmental planning efforts (e.g., State-wide Goal 5 Significant and Natural Features Inventory projects), to the high degree of citizen participation in the city's recycling programs. Participation in the preservation of chinook salmon habitat is consistent with the City's position to take actions that contribute to overall environmental and community health.

Second, the City administration has a fiduciary responsibility to its residents to protect their interests through responsible decision-making and actions. Such decisions apply to the ESA listing of chinook salmon where the City has compared the costs and benefits of complying with federal rules and the protections that compliance offers to the potential risks, liabilities and costs of non-compliance. The City has determined that compliance with the federal rules governing chinook salmon habitat, specifically the ESA Section 4(d) Rules, to be more beneficial than potentially costly third-party law suits challenging the City to demonstrate compliance with these federal rules.

## ENDANGERED SPECIES ACT: THE SECTION 4(D) RULE AND REGULATING AGENCY

The controlling federal legislation is the ESA, which was passed in 1973 (see Chapter II). Species listed under the ESA are subject to special regulations designed to protect them from extinction. A jurisdiction that fails to provide adequate protection may be subject to federal intervention or third-party legal challenge to demonstrate that the jurisdiction is providing sufficient protections to meet the requirements of the ESA. Should a jurisdiction fail to demonstrate that it is protecting the listed species, that jurisdiction could be subject to civil and criminal penalties (ESA Section 9).

There are specific ESA sections that provide guidance for complying with the ESA (i.e., Sections 10, 7, and 4). Concerning listed salmonids in streams and rivers in the northwestern United States, the federal government has developed a set of guidelines under ESA Section 4(d), which jurisdictions can follow to ensure compliance.

In July 2000, NOAA Fisheries, the federal agency with regulatory authority for marine species including anadromous fish, published the final ESA Section 4(d) Rules for protection of listed salmonids in the northwestern United States (including Upper Willamette Spring Chinook Salmon). Importantly, the ESA Section 4(d) Rules allow incidental take as long as the local jurisdiction can ensure that, overall, it will not create any "jeopardy" to a listed species of becoming either endangered or extinct. These rules, developed specifically for listed northwestern salmonids, provide options for jurisdictions to obtain an incidental take permit from NOAA Fisheries for its activities. This permit ensures compliance with the ESA and provides protection in the event of legal challenges by the federal government and/or other parties.

## CORVALLIS ESA RESPONSE PLAN HISTORY

The City initiated a formal response to the listing of chinook salmon in the Summer of 2000 when it began the project to identify chinook habitat, City and citizen activities that could degrade habitat, and solution options to protect chinook habitat from further degradation. In the years leading up to the project, the City had become aware of the potential for chinook to be listed as threatened under the ESA and the requirements to comply with ESA.

City officials supported state and region-wide efforts to protect salmon. They participated in the "Oregon Plan for Salmon and Watersheds", which was a state-lead effort to address declining populations of salmon with a pro-active, coordinated effort for restoration of the state's salmon habitat that included federal and state agencies, local jurisdictions, and community-based groups in the process. The City became a member of the Willamette Restoration Initiative (WRI), whose goal was to coordinate efforts to protect and restore the health of the Willamette River watershed.

Locally, the City had initiated several efforts that both highlighted potential fish habitat problems and proposed a number of rehabilitation measures. The City's comprehensive stormwater management planning effort identified potential water quality problems from untreated stormwater run-off to streams. While the City funded an extensive combined sewer overflow (CSO) project to capture and treat wastewater and stormwater run-off from the older areas of the community that previously discharged untreated stormwater to the Willamette River, it also recognized that other unprotected streams would continue to be contaminated without additional policy and development changes. In addition, the City was beginning to prepare for the periodic review of the its Comprehensive Plan, which required extensive inventories of its environmental resources, including fish habitat in city streams.

City residents were also aware of the declines of salmonid populations in the northwest and generally were supportive of efforts to seek solutions to restore fish habitat. Among the evidence of such support was an annual random survey of residents that the City conducted to measure service effectiveness. While residents traditionally favored the City's environmental programs, in 1999 specific questions were included in the survey regarding the recently ESA-listed chinook salmon. Though no specific actions were identified, residents responded overwhelmingly positively to the need to support City activities that address chinook salmon habitat, even if it required modification of city services (wastewater treatment, water supply, stormwater management, etc.) and land development regulations.

The City budgeted for a multi-year project to develop an Salmon Response Plan. The Plan would assess chinook salmon habitat in streams within the its urban growth boundary (UGB), and develop a response plan based on sound science that would 1) prevent further chinook salmon habitat degradation and 2) eventually put the habitat on a trajectory toward PFC. The City hired a team of consultants with expertise in the ESA, chinook salmon biology and ecology, and the recently implemented ESA Section 4(d) Rules. The project was initiated in the Fall of 2000 (see project area map in Figure 2).

## KEY PROJECT TASKS

The project's scope of work outlined a two-phased approach that coordinated the efforts of the City's TAC, the public (both stakeholders and general public), and the consulting team. The City recognized that project success hinged on significant communication between the City and NOAA Fisheries. Communication began in the project's early stages to ensure that the City received the benefit of guidance from the agency which would receive the City's report and provide the incidental take permit under ESA Section 4 (d). Frequent communication continued throughout the entire project.

Phase One of the project developed a comprehensive environmental baseline documenting the existing conditions of city streams for chinook salmon habitat. A pathways/effects analysis assessed the impact of City activities and citizen behavior on chinook salmon habitat.

Phase Two used the pathways/effects analysis to determine the degree and geographic distribution of City activities and citizen behavior that negatively impacted habitat. Activities were weighted and ranked according to their impact in order to identify solution options to prevent further habitat degradation and eventually restore PFC.

The combined effort of the two-phased approach would be the preparation and submission of an ESA Section 4(d) Rule Limit 12 (Municipal, Residential, Commercial, and Industrial Development Program) application to NOAA Fisheries. The application would document the City's understanding of chinook salmon habitat, City activity and citizen behavior impacts, and solutions that would be implemented to meet ESA requirements.

**Figure 2. Corvallis Salmon Response Plan Project Area**

*See separate file*

To accomplish this project the following key tasks were completed:

- Development of an existing conditions database (existing sources and field data collection).
- Production of a geographic information systems (GIS) map of city streams with a 400-foot riparian corridor evaluation area (200 feet on each side of the top of bank).
- Creation of a pathways/effects evaluation of City activities (e.g., public infrastructure and services, transportation, operations and maintenance activities, parks and recreation, land use planning etc.) and citizen behavior (e.g., household activities, yard maintenance, home auto repairs, etc.).
- Preparation and submittal of the Phase One report "Baseline Habitat Evaluation and Evaluation of Impacts of City Activities" to NOAA Fisheries (approved by NOAA Fisheries in January 2002).
- Development of a database of weighted data that compared the pathways/effects analysis of City activities and citizen behavior against the baseline conditions database to determine the degree of chinook salmon habitat impact and its distribution.
- Development of solution options to prevent further degradation of chinook salmon habitat.
- Development of solution options to put the City on a trajectory toward achieving PFC in its streams.
- Development of a monitoring program.
- Preparation of a final report combining both phases of the project into a single report for submission to NOAA Fisheries.
- Provide extensive public involvement activities throughout the project (stakeholder and open house meetings, press releases, comment forms, project website, etc.) to ensure public understanding of the project and to provide the general public with an opportunity for input.

# CHAPTER 2. ESA AND THE 4(D) RULE

## INTRODUCTION

Since the project is driven by the ESA, it is important that the reader have a basic understanding of the ESA and how it applies to the Salmon Response Plan. The following sections briefly describe the ESA including its purpose, the listing process, enforcement, and the compliance options available to local agencies, which can impact listed species within their jurisdictions. This chapter concludes with a more detailed discussion of the 4(d) Rule and the guidance it provides for listed salmonids.

## A BRIEF HISTORY OF THE ESA

Since its passage in 1973, the ESA has become the most important environmental legislation for the protection and conservation of plant and animal species. The ESA is a federal action that is designed to prevent the extinction of wildlife, fish and plants. The ESA covers the listing and delisting process, prohibited activities; enforcement and penalties for violators, exceptions to the ESA, and importantly for Corvallis, guidelines for protecting and conserving threatened species.

The primary motivation for the Act's passage was the recognition that economic growth and development was responsible, in part, for species extinction. The Act's findings stated that previous species extinction was the "consequence of economic growth and development untempered by adequate concern and conservation." The Act's findings further stated that fish, wildlife, and plants were of "esthetic, ecological, educational, historical, recreational, and scientific value to the Nation [and international community] and its people." To conserve species and prevent future extinctions, the United States Congress passed the ESA with sweeping powers to, "provide a program for the conservation of such endangered species and threatened species..." and that <u>all</u> "...Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act."

### Threatened and Endangered: Important Distinctions

There are two important designations under the ESA, endangered and threatened, each having different prohibitions and restrictions. An endangered species is defined as, "any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary [of Commerce] to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man." A species that is listed as threatened, on the other hand, is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

The two designations differ significantly with respect to the prohibited activities. While both are subject to the "take"[1] prohibitions (Section 9 Prohibited Acts), those for endangered species are significantly more restrictive because of the potential for extinction. Essentially, any human-related activity that could result in extinction of the species outside of self-protection (an act of self-defense by humans) from an endangered species is considered unlawful. Included in these prohibitions are the sale and trafficking (importing, exporting), possessing, and violation of any regulation pertaining to the endangered species.

There are exceptions to these prohibitions. Incidental take of an endangered species may be permitted as long as it does not create jeopardy. That is, the take of the endangered species does not result in the species' extinction. Therefore, ESA Sections 7 (Interagency Cooperation) and 10 (Exceptions) allow the "take" of species listed as threatened or endangered, as long as there is no possibility that it will become extinct.

Prohibited activities under the threatened species designation are subject to the same ESA sections, though they are somewhat less restrictive. Like endangered species, there are incidental take prohibitions, but there are also exceptions. The exceptions are significantly more flexible than those for endangered species. Incidental take can happen only if it does not result in jeopardy. That is, that the take will not result in a threatened species becoming endangered.

What differs between the two designations is the application of Section 4(d) Protective Regulations. Section 4(d) only applies to threatened species. It gives the Secretary of Commerce sweeping authority to prepare any regulations necessary to conserve (save) a listed threatened species including, under certain circumstances, allowing exemptions from prohibited activities in other sections of the ESA such as Section 9(a)(1). Section 9(a)(1) lists prohibited activities for listed threatened species including importing/exporting, transporting, selling, damaging/destroying, or violating any regulation related to a threatened species promulgated by the Secretary of Commerce.

**ESA Listing Process**

Listing of species under the ESA is a three-step process (ESA Section 4). In the first step, a species review is triggered by a petition to the Secretary of Commerce claiming other laws and regulations have not sufficiently protected the species, and ESA protection is warranted. The petition must present the scientific evidence leading to that conclusion. A biological review team (BRT) is formed and a "status review" conducted. This review has at least five possible outcomes. The BRT may conclude that there is insufficient cause for listing and reject the petition, that the petition has presented insufficient evidence for listing and reject the petition, or that the evidence is insufficient for listing but the species should

[1] The term ''take'' in the ESA means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

be designated as "candidate" and re-examined in five years. Should the BRT find that listing is warranted, it may either decide that, while listing is warranted, other species have greater urgency and so the species in question will not be listed at this time, or that listing is necessary.

In the second step, there is additional scientific review and public comment for the proposed listing of the species. At this time other governmental agencies are "obligated" by Section 7 of the ESA to consult with the regulatory agency (e.g., NOAA Fisheries, U.S. Fish and Wildlife Service) on any projects involving federal actions (including funding) to protect the proposed species and its habitat. Federal regulations, however, do not yet apply to state and local authorities because the species has not been formerly listed.

In the third step, the ESA lists the species when scientific review and public comment in the second step warrant further protections. At this point state, local and private citizens along with federal government agencies are all required by Section 7 of the ESA to consult with the federal regulatory agencies on any federal actions that may impact the listed species. The Section 7 consultation process ensures, for a specific project, that the listed threatened species is not in jeopardy of becoming endangered and the listed endangered species is not in jeopardy of becoming extinct. Through the consultation process a proposed project may be modified, altered, or even prevented depending on the federal agency's determination of impact on the listed species.

**Chinook Salmon Listing History**

The ESU for Upper Willamette Spring Chinook Salmon was listed as threatened on March 24, 1999. The final determination to list these salmon as threatened came after a year of scientific analysis and public comment. During that time NOAA Fisheries reviewed the potential listing of eight chinook salmon stocks along the west coast of the United States. In March 1999, three other chinook stocks also were listed under the ESA, two as threatened and one as endangered (Federal Register March 24, 1999). Decisions on the remaining chinook stocks were postponed for six months in order to extend the review period.

At the time of the listing NOAA Fisheries also was required to designate critical habitat for Upper Willamette Spring Chinook Salmon (ESA Section 4(a)(3)(A)). Critical habitat as defined in the ESA is ''(i) the specific areas within the geographical area occupied by the species...on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species...upon a determination by the Secretary [of Commerce] that such areas are essential for the conservation of the species.'' (ESA Section 3(5)(A)).

NOAA Fisheries postponed designation of critical habitat in March 1999 because of the number of comments received regarding critical habitat area. Critical habitat was finally designated on February 16, 2000 (Federal Register Vol. 65, No. 32). The critical habitat designation for Upper Willamette Spring Chinook Salmon, as well as for 18 other salmon stocks, were then voluntarily vacated April 30, 2002 in response to litigation challenging the process by which critical habitat was established.

To date, the critical habitat designation is still vacated pending the review of the critical habitat designation process by NOAA Fisheries. Upper Willamette Spring Chinook Salmon remains listed as threatened under the ESA and jurisdictions must still demonstrate that they are conserving habitat under other federal legislative mandates (i.e., Magnuson-Stevens Act of 1996).

**Section 4(d) Rules**

As was noted in a previous section of this chapter, the federal government has flexibility to issue regulations that allow exceptions to the take prohibition. There are three Sections of the ESA that guide the type of exceptions that may be allowed for a listed threatened species designation. Section 4(d) is one of the ESA sections that provides regulatory flexibility when the Secretary of Commerce deems it is "necessary and advisable to provide for the conservation of such [as listed threatened] species." NOAA Fisheries has used this section to develop specific rules for listed anadromous fish, including Upper Willamette Spring Chinook Salmon, to provide guidance to jurisdictions on how to demonstrate conservation of these listed species' habitat.

NOAA Fisheries formally adopted the Section 4(d) Rules on July 10, 2000 (Federal Register Vol. 65, No. 132). The Rules identified activities that NOAA Fisheries believed might constitute a "take" of listed species. The Rules also identified activities that "conserve" listed species; that is, activities conducted pursuant to NOAA Fisheries-approved land use regulations. The Rules identified 13 activities or programs that NOAA Fisheries believed limited impacts on salmonid species, so that additional protection through application of ESA Section 9 would be unnecessary.

NOAA Fisheries intended to use the 4(d) Rule process as a way to encourage governments to review their regulations and make changes to ensure activities conducted pursuant to such regulations did not cause a "take." NOAA Fisheries actively encouraged and was "interested in working with local jurisdictions to develop programs that protect endangered and threatened species and their habitats and to recognize such programs through 4(d) Rules exceptions or other mechanisms." (*ESA and Local Governments: Information on 4(d) Rules*, NOAA Fisheries, 2000).

The 4(d) Rules set forth an administrative process whereby governmental entities could except their land use and water quality regulations from ESA restrictions. In practical language, NOAA Fisheries recognized that implications of the listed species were for the first time mainly on urban rather than rural areas. Therefore, certain activities such as urban development, the delivery of urban services (e.g., public infrastructure, operations and maintenance, etc.) and citizen behavior as well as the history of urban development and activities were very complex and would likely violate Section 9 take prohibitions. In order to both comply with the ESA, but still allow for the continued activities that were primarily urban in nature, there had to be some guidance for local jurisdictions to demonstrate compliance. The Section 4(d) Rules provided that guidance.

Further, NOAA Fisheries recognized that the 4(d) Rules "did not require states, local governments, or private parties to change their practices to conform to any of the take limits described in the final rule. However, the limits provided one way to be sure an activity or program did not risk violating the take prohibitions. Simply because a program was not within a limit *does not* mean that it automatically violated the ESA, but that a program or jurisdiction would risk ESA penalties if the activity in question took a listed fish. By qualifying for a limit, governments and individuals received assurance that their activities, when implemented in accordance with the criteria in the 4(d) Rules, did not violate the take prohibitions and would not be subject to enforcement actions." In other words, NOAA Fisheries could not charge a jurisdiction or individual with violating the take prohibitions if they were complying with an approved 4(d) Rule plan.

**Description of the 13 Limits**

The 13 limits cover a broad number of categories where take may occur, including:

- Scientific research conducted or supervised by, or coordinated with, state fishery agencies
- Fish harvest activities
- Artificial propagation programs
- Habitat restoration based on watershed plans
- Properly screened water diversions
- Routine road maintenance
- Municipal, residential, commercial, and industrial development and redevelopment
- Forest management practices in the State of Washington

To help guide local jurisdictions through the 4(d) Rule compliance process, NOAA Fisheries has also issued the *Implementation Binder for Threatened Salmon and Steelhead on the West Coast* (September 22, 2000). The Binder outlines the steps for evaluating the need for a limit, the limit to be submitted, the contents of the limit documentation and the submittal process (See Appendix 1 for a copy of the revised Binder)

The following briefly addresses each of the 13 limits under the ESA Section 4(d) Rules (descriptions are from the *4(d) Rule Implementation Binder for Threatened Salmon and Steelhead on the West Coast*, September 22, 2000). Not all apply to the City of Corvallis and their ESA program. The City is in the process of submitting an application for Limit 9 (Water Diversion Screen for the Taylor Water Treatment Plant Intake Pump Station), will submit an application for Limit 12 (Municipal, Residential, Commercial, and Industrial Development Program) following the Land Development Code Phase III Update process, and is considering an application for a Limit 10 (Routine Road Maintenance).

*Limit 1 -- ESA Permits*

This limit recognizes that those holding permits under Section 10 of the ESA (or receiving other exemptions under the ESA) are not prohibited from take that is in accordance with the permit or applicable law. A Section 10 permit (e.g., Habitat Conservation Plan) allows a jurisdiction to take listed fish based on the plan and not be in violation of the ESA.

*Limit 2 – Ongoing Scientific Research*

NOAA Fisheries allowed a temporary, one-time limit on the ESA take prohibitions to allow scientific activities to continue until March 7, 2001. Authorization under this limit did not remove a researcher's obligation to obtain any additional state, tribal, or federal permits. Nor did this limit remove the need for federal researchers to consult with NOAA Fisheries under Section 7 of the ESA.

*Limit 3 – Rescue and Salvage Actions*

This limit relieves certain agency and official personnel (or their designees) from the take prohibitions when they are acting to aid an injured or stranded fish or salvage a dead fish for scientific study.

*Limit 4 – Fishery Management*

Allows the take of listed fish in fisheries if a fishery management agency develops a Fisheries Management and Evaluation Plan (FMEP) and NOAA Fisheries approves it. Some benefits of the FMEP approach are long-term management planning, more public involvement, less government paperwork, and more certainty that there will be fishing opportunities in the future.

*Limit 5 – Artificial Propagation*

Hatcheries can be managed in a manner that conserves and recovers listed salmon and steelhead. The 4(d) Rules do not prohibit the take of listed fish for a variety of hatchery purposes if a state or federal hatchery management agency develops a Hatchery and Genetics Management Plan (HGMP) and NOAA Fisheries approves it.

*Limit 6 – Limits on the Take Prohibitions for Joint Tribal/State Plans Developed under the United States v. Washington or United States v. Oregon Settlement Processes*

NOAA Fisheries includes this limit on the take prohibitions to accommodate any resource management plan developed jointly by the states and the tribes (joint plan) under the jurisdiction of *United States v. Washington* or *United States v. Oregon*. Such a plan would be developed and reviewed under the government-to-government processes outlined in the final 4(d) Rule for Tribal Resource Management Plans.

*Limit 7 – Scientific Research Activities Permitted or Conducted by The States*

The 4(d) Rule allows take for specific scientific research activities undertaken by states. Coverage under the limit requires that the state fishery agencies either conduct or oversee research/monitoring efforts, or become involved in coordinating those efforts. In addition, compliance with the limit will require that the state fishery agencies submit annual reports describing research-related take for each of the affected ESUs.

*Limit 8 – Habitat Restoration*

The final 4(d) Rule provides that take prohibitions will not apply to habitat restoration activities that are part of a watershed conservation plan that the state of Washington, Oregon, Idaho, or California has certified to be consistent with the state's watershed conservation plan guidelines.

*Limit 9 – Water Diversion Screening*

Water diversions that operate without adequate screens to block fish access are widely known to kill salmon and steelhead. Juveniles may be sucked or attracted into diversion ditches or pipes where they later die from a variety of causes (e.g., stranding, hydropower production, drinking water treatment, etc.). In addition, juveniles are often injured or killed when caught in pumping facilities or forced against screens. Adult and juvenile salmonid migration may also be impaired by diversion structures such as push-up dams.

The 4(d) Rule does not apply take prohibitions provided that NOAA Fisheries engineering staff, or any resource agency or tribal representative NOAA Fisheries designates as an authorized officer, has agreed in writing that the diversion facility is screened, maintained, and operated in compliance with NOAA Fisheries' Juvenile Fish Screening Criteria or, in California, in compliance with NOAA Fisheries' Southwest Region Fish Screening Criteria for Anadromous Salmonids. If a diversion is screened, operated, and maintained in a manner consistent with those criteria, adequate safeguards will be in place and no additional federal protection is necessary or advisable for conserving listed fish.

The City of Corvallis prepared a Limit 9 application for replacement of its Taylor water intake diversion screen on the Willamette River. The water diversion screen was replaced during the summer and fall of 2004.

*Limit 10 – Routine Road Maintenance*

NOAA Fisheries does not find it necessary or advisable to apply take prohibitions to routine road maintenance activities provided that: (1) the activity constitutes routine road maintenance conducted by Oregon Department of Transportation (ODOT) employees (or their agents) that complies with ODOT's *Transportation Maintenance Management System Water Quality and Habitat Guide* (ODOT Guide, July 1999); (2) it is conducted by the employees or agents of a state, county, city, or port under a program that complies substantially with the ODOT Guide and has been determined to meet or exceed the protections provided by the ODOT Guide; or (3) it is conducted by the employees or agents of a state, county, city, or port in a manner that has been found to contribute to PFC.

For a state, city, county, or port program that is equivalent to the ODOT program (or any of its amendments) to qualify under Limit 10, it must be approved in writing by the NOAA Fisheries Northwest or Southwest Regional Administrator, whichever is appropriate. Any jurisdiction desiring its routine road maintenance activities to qualify under this limit must have adopted road maintenance guidelines equivalent to or better than the ODOT program and commit in writing to apply these management practices.

The City of Corvallis is considering a submission of a Limit 10 application. The City considers its routine road maintenance program equal to the ODOT Guide and in many cases exceeds ODOT practices. In addition, NOAA Fisheries has encouraged the City to submit a Limit 10 based on the Salmon Response Plan Phase One report, *Baseline Habitat Evaluation and Evaluation of the Impacts of City Activities* (February 2002).

*Limit 11 – Portland Parks Integrated Pest Management*

After carefully analyzing the City of Portland's Parks and Recreation (PP&R) integrated program for pest management, NOAA Fisheries concludes that it addresses potential impacts and provides adequate protection for listed fish. NOAA Fisheries does not find it necessary or advisable to apply additional federal protections in the form of take prohibitions to PP&R activities conducted under the Pest Management Program.

This limit only covers the City of Portland. The City has worked closely with NOAA Fisheries to develop a program that covers their activities. NOAA Fisheries has not expanded it to allow other jurisdictions adopt their program as they have for Limit 10.

*Limit 12 – Municipal, Residential, Commercial and Industrial Development and Redevelopment*

The City will submit an application under Limit 12. The Municipal, Residential, Commercial and Industrial (MRCI) limit application is complicated because it covers many of the diverse activities that a city provides. Through the 4(d) Rule, NOAA Fisheries identifies a mechanism whereby cities, counties, and regional governments can ensure that MRCI development and redevelopment authorized within those areas is consistent with ESA requirements. The challenge is to be able to provide adequate protections to prevent

Upper Willamette Spring Chinook Salmon from becoming endangered, which at the same time allows local jurisdictions enough flexibility to continue to conduct their business. The 4 (d) Rules allow this as the take prohibitions do not apply to MRCI development or redevelopment governed by and conducted in accordance with city, county, or regional government ordinances or plans that NOAA Fisheries has found to adequately protect listed species.

NOAA Fisheries has developed 12 criteria by which a Limit 12 application will be evaluated. The following criteria will be applied by NOAA Fisheries when evaluating the MRCI program plans and ordinances:

- Avoid development in inappropriate areas (e.g., steep lopes, wetlands, riparian areas)
- Avoid stormwater discharge impacts to water quality, quantity and the watershed hydrograph
- Provide riparian area management that adequately maintains properly functioning conditions and mitigates unavoidable damage
- Avoid stream crossings by roads, utilities, etc., when possible, and minimize impacts where crossings are unavoidable through choice of mode, sizing, and placement
- Protect historical stream geomorphology and avoid hardening of banks and shorelines
- Protect wetlands and wetland functions
- Preserve hydrologic capacity of all streams, permanent and intermittent, to pass peak flows
- Provide for and encourage use of native vegetation for landscaping to reduce water, pesticide and herbicide use
- Ensure water supply demands can be met without having a negative impact on flows, directly or through influences on groundwater. Any new diversions should be placed and screened in such a way as to prevent injury to and/or death of salmonids
- Provide necessary enforcement, funding, reporting, and implementation mechanisms and formal plan evaluations at no greater than 5 year intervals
- Comply with all other state and federal environmental and natural resource laws
- Provide NOAA Fisheries with annual reports regarding implementation and effectiveness

*Limit 13 – Forest Management in Washington*

NOAA Fisheries has determined that it is not necessary to apply take prohibitions to non-federal forest management activities conducted in the State of Washington provided that: (1) the action complies with adopted forest practice regulations that NOAA Fisheries has found to protect habitat functions at least as well as the regulatory elements of the Forests and Fish Report (FFR); and (2) the activity also implements all non-regulatory elements of the FFR.

# CHAPTER 3. PROJECT STRUCTURE

## INTRODUCTION

When the City of Corvallis decided to undertake a project to address the ESA and prepare an application using the Section 4 (d) Rules as guidance, the City involved itself with a process not previously accomplished. Few other local jurisdictions had evaluated the impact of their activities on listed salmonids in the Pacific Northwest. In jurisdictions that attempted to do so (e.g., Clark County, Washington; Clackamas County, Oregon; and the City of Sandy, Oregon) such attempts were considered inadequate by NOAA Fisheries. Without a template or road map to follow, the City had to develop a new and innovative approach if it wanted to meet the compliance requirements.

This chapter addresses the innovative project structure that the City developed to assess the baseline fish habitat conditions, evaluate city and citizen impacts on fish habitat, and identify and implement solutions that protect habitat and actually put habitat on a trajectory toward achieving PFC. The following project elements are addressed:

- Project area
- Data collection area and reach definition;
- Task structure of the two-phased project;
- Project team, coordination and oversight, project team management, Urban Services Committee (USC), Technical Advisory Committee (TAC), professional consultant,
- Agency/jurisdiction coordination (NOAA Fisheries and other regulating agencies), local jurisdiction coordination (i.e., Benton County, Oregon State University, other jurisdictions); and
- Public involvement (e.g., residents, interested public, conservation groups, business groups, etc.).

## PROJECT AREA

When Corvallis was identifying the project boundary, it considered the area within the City limits and immediately outside the city limits within the urban growth boundary (UGB) as important to the project. While UGB land was in Benton County, because of the influence the City exerted on the surrounding county land and development activities, the City felt that the entire UGB should be included as part of the project area (see Figure 2 in Chapter 1).

This expanded City project area had advantages. First, the larger area allowed the City to address a much larger part of the watershed. Including the UGB doubled the project area to approximately 17,900 acres (8,962 for the UGB, 8,942 for the City). Second, the project would extend cooperation between the two jurisdictions to include environmental activities. Third, solution options and programs requiring joint implementation would more likely be successful if both jurisdictions participated in the project. Finally, cooperation between jurisdictions would meet one of NOAA Fisheries main goals, which was to encourage collaborative efforts to address salmon habitat protection.

## DATA COLLECTION AREA AND REACH IDENTIFICATION

One of the main tasks of the project was to create an environmental baseline or existing conditions database that accurately described the chinook salmon habitat in the project area. Accomplishing this task required a review of existing data and information, identification of data gaps and fieldwork to fill the data gaps.

A critical concern for developing the environmental baseline was related to the areas that were to be surveyed. What steams would be included, how would the data be organized and, for efficiency purposes, could the project rely on previous or on-going City environmental projects to minimize duplication of effort?

### Stream Corridor Width and Basin Organization

One of the first steps was to determine the research area to be studied. While the project would obviously review and collect data on all water-courses (streams and rivers) within the project area, how far back from the top-of-bank would be reasonable to conduct research and collect data? Guidance on the width of the investigation area came from a NOAA Fisheries discussion on salmonid critical habitat (Federal Register February 16, 2000).

Salmonid research suggested that the most significant area of habitat influence on salmon habitat was the riparian area as it provides shade, sediment transport, nutrient or chemical regulation, stream bank stability, and input of large woody debris or organic matter. While the literature varied on how wide the riparian area should be (varying from 300 feet to formula based on the length of one "site potential" tree), there was agreement that widths should be wide enough to capture these important habitat-sustaining functions. NOAA Fisheries also recognized that different land uses and activities (e.g., urban land types, development, agriculture, etc.) could severely diminish the riparian area's habitat sustaining functions.

The project team decided that although much of the project area was impacted by urban land uses, which reduced the width of a riparian area's habitat-sustaining function, they were concerned about evaluating as much of the potential riparian area as reasonable, even if it did not currently provide chinook habitat-sustaining functions. Therefore, a 400-foot-wide corridor (200 feet from top of bank on both sides of the watercourse) was selected as the area of research. The project team considered this a reasonable corridor width because it would ensure developing a database covering any future buffer width restrictions that NOAA Fisheries could require for ESA compliance. Data collected from within this 400-foot width also would be useful in meeting the Oregon statewide Goal 5 (Open Spaces, Scenic and Historic Areas and Natural Resources Goal) significant natural features identification project objectives.

The project team also decided to organize the project and existing conditions database around the stormwater basins used for the Stormwater Master Plan (SMP). The SMP had divided the City into a series of stormwater basins. All work on the SMP from data collection to project improvement identification was categorized into these stormwater basins. By using the same format the ESA project had a ready-made template for data collection and analysis, as well as the ability to tie any future ESA solution options that were stormwater-related directly into the SMP to satisfy multiple objectives.

**Reach Identification**

In order to be able to accurately describe chinook salmon habitat, the project area was divided into discrete sections. This allowed for the collection and assembly of the data, and assessment of the varying conditions across the area. The major watercourses (Mary's and Willamette Rivers, and Dunawi [formerly known as Squaw Creek], Oak, and Dixon Creeks) were divided into 27 reaches. For study purposes, stormwater basins that either did not have one of the listed watercourses or had a watercourse above the Jackson Frazer Wetland, which acted as a natural barrier to fish passage, were each categorized as a reach. A total of 42 reaches were identified.

Reach boundaries along the watercourse were determined by break in riparian community structure (e.g., development features such as roadway intersections and bridge crossings, changes in land use, changes in riparian vegetation from native to non-native, and natural features such as creek confluences). Preliminary reach boundaries were identified by aerial photography. These were then "ground-truthed" and refined during fieldwork data collection. The SMP stormwater basin boundaries were used for the stormwater basin reaches. Table 1 defines the reaches and boundaries for the watercourses and Figure 3 displays the reaches that were used in this evaluation.

**Table 1. Reach/Stormwater Basin Approximate Boundaries**

| **Reach** | **Description** | **Approx. Beginning** | **Approx. End** |
|---|---|---|---|
| DCR1 | Dixon Creek Reach 1 | Willamette River | SW 9th Ave |
| DCR2 | Dixon Creek Reach 2 | SW 9th Ave | NW Garfield |
| DCR3 | Dixon Creek Reach 3 | NW Garfield | NW Circle Blvd |
| DCR4 | Dixon Creek Reach 4 | NW Circle Blvd | Walnut Blvd |
| DCWF | Dixon Creek West Fork | Walnut Blvd | UGB |
| DCEF | Dixon Creek East Fork | Walnut Blvd | Headwaters |
| DCMF | Dixon Creek Middle Fork | Walnut Blvd. | UGB boundary |

**Table 1. Reach/Stormwater Basin Approximate Boundaries**

| Reach | Description | Approx. Beginning | Approx. End |
|---|---|---|---|
| OCR1 | Oak Creek Reach 1 | Mary's River | Hwy. 20 |
| OCR2 | Oak Creek Reach 2 | Hwy. 20 | SW Jefferson Ave |
| OCR3 | Oak Creek Reach 3 | SW Jefferson | Walnut Blvd |
| OCR4 | Oak Creek Reach 4 | Walnut Blvd | UGB |
| OCNTR1 | Oak Creek North Tributary Reach 1 | Walnut Blvd | 0.75 mile upstream |
| OCNTR2 | Oak Creek North Tributary Reach 2 | 0.75 mile upstream | Walnut Blvd |
| OCNTR3 | Oak Creek North Tributary Reach 3 | Walnut Blvd | UGB |
| OCNTWF | Oak Creek North Tributary West Fork | Walnut Blvd | UGB |
| DuCR1 | Dunawi Creek Reach 1 | Mary's River | Brooklane Dr/ Stratton Way |
| DuCR2 | Dunawi Creek Reach 2 | Brooklane Dr/ Stratton Way | 0.25 mile upstream |
| DuCR3 | Dunawi Creek Reach 3 | 0.25 mile upstream | SW 35$^{th}$ Ave |
| DuCR4 | Dunawi Creek Reach 4 | SW 35$^{th}$ Ave | Confluence S & N Fork Dunawi Creek |
| DuCNFR1 | Dunawi Creek North Fork Reach 1 | Confluence S & N Fork Dunawi Creek | Hwy 20 |
| DuCNFR2 | Dunawi Creek North Fork Reach 2 | Hwy 20 | NW 63$^{rd}$ St |
| DuCNFR3 | Dunawi Creek North Fork Reach 3 | NW 63$^{rd}$ St | UGB |
| DuCSFR1 | Dunawi Creek South Fork Reach 1 | Confluence S & N Fork Dunawi Creek | Sunset Park |

**Table 1. Reach/Stormwater Basin Approximate Boundaries**

| Reach | Description | Approx. Beginning | Approx. End |
|---|---|---|---|
| DuCSFR2 | Dunawi Creek South Fork Reach 2 | Sunset Park | Walnut Blvd |
| DuCSFR3 | Dunawi Creek South Fork Reach 3 | Walnut Blvd | UGB |
| MRR | Mary's River Reach | Willamette River | UGB |
| WRR | Willamette River Reach | Entire east project boundary | |
| Adams Jefferson | Adams Jefferson | Stormwater MasterPlan (SMP) | SMP |
| Dry Creek | Dry Creek | SMP | SMP |
| Fillmore | Fillmore | SMP | SMP |
| FRAZIER | Frazier Creek | SMP | SMP |
| Garfield | Garfield | SMP | SMP |
| Goodnight | Goodnight | SMP | SMP |
| JACKSON | Jackson Creek | SMP | SMP |
| LEWISBURG | Lewisburg | SMP | SMP |
| Madison | Madison | SMP | SMP |
| Mill Race | Mill Race | SMP | SMP |
| North East Corvallis | North East Corvallis | SMP | SMP |
| Ryan Creek | Ryan Creek | SMP | SMP |
| SEQUOIA | Sequoia Creek | SMP | SMP |
| Village Green | Village Green | SMP | SMP |
| Western | Western | SMP | SMP |

**Figure 3. Stream Reaches with 400-foot Stream Corridor Evaluation Area Identified**

*See separate file*

## TWO PHASED PROJECT STRUCTURE

The project was divided into two phases. The phases can generally be categorized into baseline conditions/problem identification (Phase One), and solutions identification/plan preparation (Phase Two).

### Phase One

Phase One was primarily data collection and analysis. The major effort was to develop a scientifically based dataset that would accurately describe the existing chinook salmon habitat conditions within the project area and to develop a pathways analysis that identified existing city activities and citizen behavior that could impact chinook habitat.

Project tasks were structured to focus on the scientific methodology that would be developed to collect and analyze the data, and the databases that would be prepared to conduct the analysis. While the following chapter (Chapter 4) describes the scientific methodology used, six distinct tasks were used to develop the baseline conditions. These tasks covered the following activities:

- Project initiation
  - Develop project goals and objectives
  - Identify problem set
  - Develop public involvement plan and outreach/education approach
  - Conduct initial public involvement (stakeholders meetings)
  - Conduct initial federal regulating agency contact (NOAA Fisheries)
- Methodology development and data collection
  - Develop the methodology for data collection and analysis, including approval of the methodology by NOAA Fisheries
  - Prepare the database structure for baseline data and pathways analysis
  - Identify project area and data collection area
  - Collect existing data and determine data gaps
  - Collect field data and enter into database
- Evaluate data
  - Conduct initial baseline conditions data analysis
  - Present findings to the TAC
  - Revise findings based on comments
- Risk assessment
  - Assess the City's risk for chinook salmon habitat degradation

- Pathways/Effects Analysis
  - Review and document city activities (reports, interviews, field investigation)
  - Review and document citizen activities (interviews and field investigation)
  - Develop preliminary pathways/effects database
- Preliminary reporting
  - Develop preliminary findings based on existing habitat conditions and pathways/effects analysis
  - Meet with NOAA Fisheries to review preliminary findings
  - Facilitate open house/public meeting to provide information and obtain public comment
  - Prepare initial report on baseline conditions and pathways analysis
  - Submit report to NOAA Fisheries for review and approval
  - Obtain NOAA Fisheries approval of baseline conditions and pathways/effects report (approved January 2002)
  - Facilitate open house/public meeting to present results of Phase One

**Phase Two**

Phase Two focused on identifying and developing solution options that would prevent chinook salmon habitat degradation and maintain water quality. The tasks were structured to take the results of the Phase One baseline conditions and pathways/effects analysis and craft a set of reasonable and cost effective solutions to meet the requirements of the ESA Section 4(d) Rule Limit 12 and that could be implemented by the City.

The following five tasks were developed to accomplish Phase Two:

- Integrate the baseline conditions and pathways/effects databases
  - Develop a database of weighted factor scores to determine the relative impact of city activities and citizen behavior on chinook salmon habitat
  - Identify geographic distribution of city activities (by reach) that impact chinook salmon habitat
  - Rank city activities and citizen behavior based on score
  - Present preliminary findings to NOAA Fisheries for review and comment

- Identify initial program options
  - Develop preliminary set of solution options based on categories of city activity (public infrastructure, transportation, planning, parks and recreation, city operation and maintenance activities, etc.)
  - Match program options to ESA Section 4(d) Limit 12 evaluation criteria to ensure that the options meet the requirements of Limit 12
  - Seek public input on solution options (stakeholder and public meetings)
  - Refine options based on public input
  - Present solution options to NOAA Fisheries for review and comment
- Develop program strategy
  - Refine solution options and develop an implementation program
  - Assign approximate costs to the refined solution options
  - Seek second round of input from public
  - Develop final solution options
  - Develop preliminary compliance program based on input from NOAA Fisheries and the public
- Develop implementation plan and report
  - Prepare implementation plan for ESA compliance
  - Prepare report that integrates the options, rationale for option selection, implementation plan, and monitoring plan to ensure compliance
  - Present implementation plan to NOAA Fisheries for review and comment
  - Refine implementation plan and present to City Council and public

## PROJECT TEAM

The project team consisted of City project management/oversight, City and County technical advisory members, and the professional consulting team. In addition, there was elected official oversight provided by the Urban Services Committee (USC).

The project was managed through the City Public Works Department. City project management and oversight were the responsibility of the department's Utilities Division Manager and the Capital Planning and Projects Supervisor.

Since the ESA listing has an impact on City service delivery provided by several departments, the TAC was created to provide technical oversight. The TAC consisted of members from the following departments and divisions:

- Public Works Department
  - Transportation Division
  - Utilities Division
  - Engineering Division
- Parks and Recreation Department
- Community Development Department (planning division)

In addition, a representative from the Benton County Community Development Department was also a member of the TAC.

The TAC was responsible for helping set the project goals/objectives, approving the scope of work, and reviewing and approving all products and deliverables. The TAC met with the entire project team on a monthly basis. TAC members also attended and participated in all public meetings.

The professional consulting team included experts in a number of disciplines. The lead consulting firm managed the project tasks, scope of work and budget. The firm specialized in fish, wildlife, and plant biology, environmental compliance, land use planning, and economics.

The lead firm was supported by four sub-consultants: a civil engineering firm that focused on the public infrastructure issues and programs that could impact the chinook salmon habitat; a geographic information services (GIS) firm that provided GIS support to integrate the databases with GIS maps; a public involvement firm that guided the public education and outreach program; and an Oregon State University (OSU) professor who specializes in fish biology to provide additional science expertise and oversight.

**AGENCY COORDINATION**

There were a number of agencies that were important to the project. The most critical, of course, was NOAA Fisheries. As the federal regulatory agency for listed salmonids, approval by NOAA Fisheries of the Salmon Response Plan was needed. The City began contacting NOAA Fisheries early in the project. Frequent meetings (face-to-face and telephone conferences) were held between NOAA Fisheries, City representatives and the consultant team. In addition, technical memoranda related to project methodology and analysis, and project reports were forwarded to NOAA Fisheries for review and comment.

There were other public agencies that were critical to the project. The project team at various times contacted the following agencies for information, data, or reports:

- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of State Lands (DSL)
- Oregon Department of Environmental Quality (DEQ)
- Oregon Department of Transportation (ODOT)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Army Corps of Engineers (Corps)
- U.S. Environmental Protection Agency (EPA)
- Benton County
- Oregon State University (OSU)
- Corvallis School District
- Mary's River Watershed Council

**PUBLIC INVOLVEMENT/EDUCATION**

A critical component in the project was input from the public. Not only is public involvement an expressed goal of the ESA and the Section 4(d) Rules, but, strategically, it also was important to have citizen support for the Salmon Response Plan to be successful.

While Chapter 9 of this report details the public involvement activities, the following is a list of the public involvement elements that occurred throughout the project:

- Stakeholder meetings – stakeholders were identified and contacted to participate in special meetings to identify key issues of concern. These meetings were held during both phases of the project.
- Open house/public meetings – four open house/public meetings were held to present project information and to seek public input and comment. The meetings were structured to maximize public participation. Comment forms were provided to the participants and distributed throughout the community.
- An email mailing list was used to periodically inform Corvallis residents of ESA project activities and upcoming events.
- Press releases were sent to local media regarding project status.
- Fact sheet – an ESA fact sheet was prepared and distributed to the public.
- City event participation – City representatives provided information on the ESA project at events such as the County Fair and the Da Vinci Days Festival.

- Project website – a project website was developed to provided general and specific information about the project, including meeting summaries, reports, and technical memoranda that were prepared. In addition, there was a calendar included that listed upcoming public meetings and relevant deliverable dates. The website also included an online comment form for the public to use to comment on the solution options.

# CHAPTER 4. METHODOLOGY

## INTRODUCTION

The purpose of this chapter is to describe the project's scientific methodology. The following elements are addressed in the chapter:

- Description of the evaluation methodology;
- Process/steps to determine the baseline conditions (e.g., existing data collection, field research, interviews, geographic information systems, etc.); and
- Quantification/calculation factors and the rationale that justifies each numerical score so reviewers understand how a particular score is calculated and can be replicated.

## SCIENTIFIC BASIS FOR STUDY

As identified in Chapter 2, the ESA requires a strong scientific basis for methodology used in the evaluation process. It was critical that the data collection and analysis carefully follow scientific principles.

The methodology used in the analysis was developed in collaboration with the NOAA Fisheries. A series of meetings were held between the City of Corvallis, their project consultants and NOAA Fisheries in the Spring of 2001. The purpose of the meetings was to develop a methodology that would be acceptable to NOAA Fisheries. The methodology included the data elements that were to be collected, the data collection procedures, the categorization of the data, the evaluation/interpretation of the data collected and the City's proposed scoring for ranking City activities and citizen behavior in the pathways/effects analysis.

There was some concern on the part of NOAA Fisheries that any quantitative metric, no matter how carefully it was calculated, runs the risk of "hiding" or "masking" the rationale for a particular score. NOAA Fisheries recommended that any scoring methodology had to be fully explained in the report. The City agreed that all scoring methods would be carefully outlined so the reader would understand the scoring rationale and methodology.

Based on these meetings, the Corvallis project team prepared and submitted a technical memorandum (April 18, 2001) that outlined in detail the scientific approach to the methodology. The methodology incorporated the Oregon Department of Fish and Wildlife (ODFW) *Aquatic Inventories Project, Stream Survey Methods* and methods that were developed in discussions with NOAA Fisheries, as well as an approach to assessing pathways/effects for City services and citizen behavior. The technical memorandum was reviewed and approved by NOAA Fisheries (Appendix 2).

## METHODOLOGY DESCRIPTION

The following is a brief overview of the methodology developed for the data collection, analysis, and pathways/effects analysis and scoring.

### Baseline Conditions Habitat Assessment

The stream habitat inventory assessed the aquatic habitat of streams and gathered baseline data for the purpose of future monitoring activities. The data were collected according to protocols set forth in the ODFW *Aquatic Inventories Project, Stream Survey Methods*.

The inventory protocol had two phases. Phase one consisted of surveying existing fish habitat at selected reaches by estimating and measuring the physical dimensions of individual habitat units (pools, riffles, etc.) and characterizing important features (i.e., substrate, fish cover, and large wood) within each unit. Phase two involved taking detailed, site-specific data of channel morphology and substrate composition to establish a baseline for future monitoring activities. Field visits were also made to assess any barriers to fish movement in any of the streams.

Sequoia, Dixon, Oak, Dunawi, and Stewart Creeks were assessed for barriers to anadromous fish movement. Dry Creek, Ryan Creek, and the Mill Race were investigated but not selected for the barrier assessment because they were determined not to have the necessary hydraulic connection to support chinook salmon habitat. No barriers were found on the Mary's River or Stewart Slough. Oak Creek had a box culvert that forms a barrier just above its confluence with the Mary's River, and two dams on the Oregon State University (OSU) Campus at the Entomology Farm (between 30th and 35th Streets) and a pop-up dam used for summer irrigation (between 53rd and Harrison Streets). Dunawi Creek had a retaining wall constituting an impassable channel barrier at Brooklane Drive, and two box culverts at its 35th Street and West Hills Road crossings, likely impassable except to adult anadromous fish at high flows. Dixon Creek had a baffled cement box culvert at its Highway 20 crossing (6 meters upstream from the confluence with the Willamette). Higher water levels in the Willamette or removal of the boulders would make the culvert passable. It also had double box concrete culverts at its 3rd and 4th Street crossings and its Buchanan Avenue crossing. The very shallow water at low flows and high velocities at moderate and high flows create severe passage problems.

The riparian condition analysis (RCA) process was developed to inventory riparian area conditions for the ESA stream habitat assessment. The RCA process uses an assessment system that results in a score indicting how well the riparian unit functions as fish habitat. The process documents habitat characteristics such as stream size, vegetation type, and the degree of habitat modification by development. It provides scores for a set of condition modifiers, or factors, that influence fish habitat. The initial assessment was made using aerial photograph interpretation and ground-truthed with observations made during stream habitat surveys.

The process was hierarchical, with the first division made as to the nature of the riparian system; lotic (flowing) or lentic (standing). The second level (class) concerned dominant ground cover and had the following categories: forested, shrub-sapling, herbaceous, and developed. The next level (subclass) further subdivided the previous one, and described in more detail the various subclasses.

Table 2 outlines the classification system used to label the GIS riparian polygons. The information encoded in each polygon classification can be analyzed to produce a range of possible scores that can be assigned for the individual fish habitat functions. The scores are derived by GIS analysis of the mapped and classified polygons.

**Table 2. Riparian Classification System**

| Riparian System | Class | Subclass |
|---|---|---|
| Lotic (Lt)[1] riparian area adjacent to stream or river<br><br>or<br><br>Lentic (Ln) riparian area adjacent to lake or pond | Forested (FO) (at least 30% forest canopy) | evergreen (eg) |
| | | deciduous (de) |
| | | mixed (mx) (at least 30% each eg and de) |
| | Shrub-sapling (SS) (at least 30% shrub or sapling cover, less than 20 feet high) | evergreen (eg) |
| | | deciduous (de) |
| | | mixed (mx) (at least 30% each eg and de) |
| | Herbaceous (HE) | agricultural (ag) (crops, pasture) |
| | | turf(tf) |
| | Developed (DV) | residential (res) |
| | | commercial/industrial (c/i) |
| | | infrastructure (inf) |
| | | mixed (mx) |

1 - Modifiers may be used with Lotic to designate approximate stream size and channel condition

A simple example of a polygon classification is LtFOde. This denotes a deciduous (de) forested (FO) riparian area adjacent to a stream (Lt). Modifiers may be added to increase the density of information as necessary. Canopy cover, cover of shrubs or saplings, or amount of the polygon covered with developed areas were similarly quantified and documented as modifiers to the subclass category.

## CORVALLIS PATHWAYS ANALYSIS

### Pathways Descriptions

The pathways used in this report combine the concept of take with the assessment of properly functioning condition, and use it to evaluate City activities. Pathways are the links or connections between an activity and the chinook salmon habitat. It is through the pathway that an activity may impact the habitat.

There are five pathways that tie an activity and that habitat together. They are the following:

- Channelization/Instream Habitat
- Impervious Surface
- Riparian Areas
- Barriers
- Contaminants

A brief description of each pathway, as it is used in the analysis follows. How the methodology is applied to evaluate the pathways is provided in the next section.

### Channelization/Instream Habitat

As encroachment occurs in floodplains, streams become stormwater conduits. When encroachment is combined with the removal of large woody debris (LWD) from the channel, down-cutting increases (incision), stream bottom gradient increases, lateral erosion decreases, and the stream resembles a straight channel. Loss of floodplain and restriction of channel cause loss of off-channel habitat. Channelization itself causes increased velocity and increased down-cutting erosions. It severs connections between streamflow and groundwater, causes problems in the hyporheic zone, and increases difficulty of fish spawning and rearing by depriving them of oxygenated upwelling water. Channelization also degrades instream cover, off-channel and other refugial habitat, riparian conditions, hydrologic connectivity, food resources, substrate, and instream habitat quantity, diversity, and quality.

### Impervious Surface

Properly functioning condition consists of flows governed by infiltrated groundwater, overland flows, and source flows (e.g., springs, lakes, etc). This condition means that system hydrographs have fewer peaks over a longer period of time (i.e., bankfull flows occur on the order of two per five-year interval). Systems with heavy impacts can have these events several times in a year.

An increase in impervious surface can upset a stream's equilibrium as it leads to greater amounts of overland flow, as opposed to infiltrated groundwater, as one of the sources of water in the stream. Overland flows create larger water volumes in the stream in a shorter period of time. Runoff from impervious surfaces can also increase instream erosion as the stream moves toward a new equilibrium based on the new flow regime.

The results of impervious surface can lead to loss of instream habitat features (e.g., underbank cover) through erosion and transport of LWD downstream. Initially, it also increases the amount of fine sediment that is transported downstream.

If left uninterrupted by other flow regime changes, it is possible that a stream will attain a new equilibrium within approximately 20 years even with the initial increase in impervious surface. As it nears its new equilibrium, the percentage of fine sediments in the substrate decreases.

The principal effect of the increased flows is to widen the channel. This occurs because the stream must accommodate these greater flows. Bankfull width increases and pools fill in. Streamflow slows and temperature increases, due to the slower passage, loss of riparian shading, and greater surface area to be heated. Continued erosion causes the loss of overhanging cover in the pool areas. Increased sedimentation and the subsequent slowing of flows and filling of pools by finer sediments causes a loss of spawning and rearing habitat. As the channel reaches equilibrium, the higher flows flush the finer sediments away leaving coarser sediments, which may be better for spawning activities. However, spawning activity would likely be diminished if the connection between the groundwater flows and surface flows is severed as the result of changes in the hyporheic zone due to the increase in impervious surface. The higher flows may also wash fish away and the lower flows may strand them in summer when rearing is important.

The chief pathway for this change is increased impervious surface contributing to greater surface runoff and less infiltration. This leads to higher flows and a "flashier" hydrograph. Secondary pathways could be the loss of riparian habitat and decreased groundwater flows; the latter as at least the partial result of reduced infiltration of stormwater. Increased impervious surface is the direct result of increased development of all types. The more concentrated the development, the greater the amount of impervious surface. When impervious surface cover becomes approximately 10% of the total land surface, stream habitat begins to suffer. If a stream's flow reaches a new equilibrium given the increased impervious surface coverage, riparian issues become more critical to the preservation of chinook salmon habitat.

**Riparian Areas (Buffers)**

Properly functioning condition consists of buffer widths, continuity, and structure sufficient to provide streambank erosion protection, LWD, filtration of overland flow, and shading. Densely vegetated riparian areas act as filters for contaminants and nutrients, as well as infiltration areas to regulate flows. Riparian areas provide LWD, an important contributor to instream habitat structure and formation. They also provide shade for the adjacent stream, reduce bank failure, and create instream bank cover for fish.

Riparian areas function to preserve or enhance water quality by regulating temperature and by filtering contaminants, sediments, and nutrients. Temperature plays a critical role in the regulation of fish physiological function. The Clean Water Act sets temperature limits for cold-water fish species (e.g., salmonids) through the Beneficial Use portion of the Act that authorizes and justifies the Section 303(d) listings and total maximum daily load (TMDL) limits. The presence of vegetation serves to create cool-water refugia microclimate areas for fish to escape generally warmer temperatures in other portions of the stream. Riparian areas regulate temperature by shading the stream. Tall conifers perform this function best, but any woody or even tall herbaceous vegetation along the streambank or on a south slope will also do this, depending on the size of the stream. Elements important to this function include vegetation type and height, stream width, stream orientation and stream flow.

Contaminants not only include pollutants, but also sediments, nutrients, and streambank erosion. Recent research suggests that grassy buffer strips may filter out contaminants better than woody vegetation, but any vegetation will do this at some level. Aside from acting as a filter, vegetation also binds the streambank, reducing erosion. Important elements for this function are vegetation type, buffer width, riparian continuity, and slope.

Riparian areas influence fish habitat through many other significant elements, including the temperature, the contaminants, and vegetation type. Temperature and filtration effects are mentioned above, as is the securing of the streambanks. This reduces the collapsing of the banks, allowing the stream to undercut them and thereby creating fish habitat. This undercut bank habitat also may serve as a cool-water refuge. The securing of banks is an under-appreciated feature of grassy riparian zones. The prevention of instream erosion and the filtration of sediments keep important habitat features, such as spawning gravels and rearing pools, from silting in. This prevents mortality of the eggs from anoxia. It also maintains pool depth, which prevents summer mortality. Large wood serves an important role in stream habitat modification by creating pools and other instream habitat features, as well as substrate for invertebrates, which are potential food sources.

Changes in the riparian condition cause an increase in instream erosion and an eventual loss of habitat structure and diversity. The increased Horton (overland) flow of water also contributes more sediment and contaminants. Other riparian condition pathways are insufficient buffer size and structure, which diminish the functions of infiltration and filtration. If the riparian zone consists of lawns or manicured grasses, it can act as impervious surface. The presence of large wood is diminished by lowered riparian connectivity, as is the structure of the riparian zone. A zone with no large trees will contribute no LWD to the stream channel. Riparian areas with shrubs or young trees provide less shade function to a stream. Grasses shade even less and manicured grasses provide no shade function. Any vegetation on the bank will provide protection against erosion, although quality varies.

### Barriers

Barriers to fish movement include such structures as culverts and pop-up dams. Culverts create an environment where flows become considerably more powerful, but also may serve as low-flow barriers to movement. Dams without fish passage serve as blockage to movement during all flow regimes. Barriers are critical as they do not allow adult fish upstream access to spawning habitat, they do not allow juveniles access to rearing and refugia, and they do not allow juveniles downstream passage.

### Contaminants

Contaminants in the water may have a direct effect, through toxicity to one or more life stages of the fish or other elements of the food web (as measured by field discovery and/or lab testing), or indirect effects, such as sublethal impacts on growth and vitality. These effects are difficult to separate from background individual variation within a population, as well as from seasonal changes. They can, however, be highly important in the long-term survivability of the population, as their impact tends to be on lifetime reproductive output, usually through effects on growth, reproduction, sensory or motor functions, or food supply.

As can be seen by the complexity of the various pathways, channelization, impervious surface, and riparian buffers have the most diverse potential for impacts leading to take. In order to determine the impact of the City and set the habitat baseline for these impacts, the stream condition in the project area must be assessed and the nature and extent of current and future City regulatory and infrastructure activities must be measured.

## GUIDELINES FOR USING THE PATHWAY ANALYSIS WORKSHEET

### Purpose

The protocols describe and provide guidance and consistency in evaluating Corvallis Land Development Code, Comprehensive Plan and other plans and policies using the Pathway Analysis Worksheet (See Appendix 3 for example worksheets from the Baseline Database and the Weighted Pathways Database). The Pathway Analysis Worksheets have been created to systematically analyze and evaluate City documents and activities.

### Process

The process requires:

1. Screening the code, plan or policy text for sections that may impact stream habitat.
2. Citing and documenting the language and relevant information.
3. Characterizing the pathway (means by which an impact occurs).
4. Analyzing the text.
5. Scoring and documenting the results.

What follows is a step-by-step description of the process for performing regulatory analysis using the Pathway Analysis Worksheet.

*Step 1: Screening*

The first step involves screening the document (e.g., Land Development Code, Comprehensive Plan, etc.) for sections that may have positive or negative effects on stream habitat, or where a clear connection or pathway may exist but the effects are deemed neutral. When screening the key question that should be considered is:

> Key Question: Could the subject of the section (actions, uses, activities, behaviors, or authorities, etc.) have an impact on protected fish or stream habitat?

If a nexus can be discerned, then a record for the section should be entered in the worksheet.

*Step 2: Citation and Documentation*

If a record is warranted, the second step is to fill out Columns 5 through 8 in the worksheet. These items must provide a clear reference from the document item to the line item in the worksheet. The "Description" column includes either a synopsis of the language within the section, a paraphrase, or an excerpt. If more than one document will be included in the worksheet also add a document identification code in Column 1.

*Step 3: Characterize the Pathway*

The third step is to characterize the pathway by filling out Columns 2, 3 and 4 in the worksheet. This involves:

1. Identifying the pathway or conveyance as either:
    a. Channelization,
    b. Barrier,
    c. Buffer,
    d. Contaminants, or
    e. Impervious Surfaces;
2. Identifying the type of impact as either Direct or Indirect; and
3. Ascribing a positive negative or neutral influence to the pathway.

*Step 4: Analyze the Code Section, Plan, or Policy*

Step four, Analysis of the Land Development Code (LDC) Section, involves clarifying and isolating the relevant connection between the substance of the code documented in the Description, the Pathway/Conveyance, and the effect on stream habitat.

If necessary, notes, calculations, diagrams, and detailed rationale can be documented.

*Step 5: Scoring, Discussion, and Justification*

Having clarified and isolated the pathway identified in the LDC section, it can now be scored based on the following columns in the worksheet:

Filter: This column provides a useful way to categorize the language used in the code section (Definite or Conditional, Quantifiable or Non- Quantifiable).

Magnitude: This is used to describe the geographic area or extent to which the language applies.

Duration: A measure used to describe how long lasting the impacts of the pathway are to habitat.

Intensity: This is a relative measure of the level of impact of benefit or harm to habitat not associated with geographic extent (magnitude), duration, or proximity to habitat.

**General Working Rules**

- Review each document by major paragraph or section. No more than one line item should be created in the worksheet for each major paragraph or section number. If necessary, analyze subsections collectively.
- Analyze, evaluate and document only what appears within the major paragraph or section (ignore references to other sections; they will have their own line item).
- When reviewing purpose statements, vision statements, policy goals, or research that can be considered directed at water quality or stream habitat but which does not establish a conveyance or pathway, a line item may be entered without scoring the item. Also, enter an item in the worksheet when a connection to water quality or stream habitat exists and a pertinent statement or goal is noticeably absent.
- When analyzing regulatory language, screen the statements carefully to identify any causal relationship between the statement and a pathway or conveyance.
- When screening policies, goals, or vision statements only include those that seem clearly directed at habitat, water quality, or specific pathways or conveyances,or statements that might unintentionally result in tangible impacts to water quality, habitat, or a pathway or conveyance.
- Generally, introductory statements, background information, and findings of fact should not be included in the worksheet, but relevant policies that result should be included.

- Make sure the pathway is analyzed in isolation; evaluate only the impact of one section at a time. For example, if impervious surface area must be reduced as a requirement for a landscape buffer, address only the reduction of impervious surfaces; do not address to the impacts that the landscape buffer might produce (e.g. application of horticultural chemicals, or other landscape management practices). Landscape management and maintenance requirements will be analyzed elsewhere.

- Use the hardcopy of the document as work record of notes, sketches and calculations. Record detailed rationale for analysis and scoring for future reference.

- When reviewing documents the following notations are suggested when screening statements:

  NA: Not applicable; this indicates that the section does not have a tangible connection to stream habitat.

  (i): This indicates that the section may have some relationship to habitat or water quality, but the connection is not tangible, or is inconsequential. For example, a policy statement to perform environmental plans or studies has no tangible benefit or impacts upon habitat, although there is an obvious relationship.

  CD: This indicates that the policy statement is a "Code Direction." If the Code has been reviewed, no entry should be made in the worksheet to avoid redundancy.

  REF: This indicates that the statement refers, authorizes, or directs another document. If the document is to be reviewed, do not make an entry in the worksheet. If not, research the reference and make an entry.

  Fringe: Indicates that the section pertains to areas outside the study area.

- Weight the impacts of overlay zones, conditional uses, and mixed-use zones that replace base zoning against the activities and uses it is likely to replace (e.g. commercial). Replacing commercial zoning with mixed-use zoning may eliminate the possibility of more intensive commercial uses.

**Column Definitions**

Line Reference Number: This column is used to record a sequential number for each section of code analyzed in the worksheet for cell reference purposes.

Document ID: This column is used to indicate the document being analyzed. A three-letter abbreviation is used (e.g. Corvallis Comprehensive Plan – CCP).

Impact Type: This column documents whether the impact pathway is **direct** or **indirect**. Direct impacts are those that directly impact stream habitat; for example, contaminants released directly into the waters of a salmon-bearing stream. Contaminants released on land, or those that enter stormwater systems would be indirect impacts.

Pathway/Conveyance: This column indicates the pathway or conveyance of the impact. Pathways should be classified as one of the following:

1. Channelization,
2. Impervious Surfaces,
3. Contaminants,
4. Barriers, or
5. Buffers.

Statements can be included in the worksheet that do not correspond to a specific pathway or conveyance. Either multiple pathways or conveyances may apply, or the statement may be too general to tie to a specific pathway or conveyance. In such cases the column should be used to indicate either "Multiple", or "Not Applicable" (NA).

+/-/0: This column is used to qualify the impact of the code section on habitat as, positive, negative, or neutral. For example, a code section with a positive impact might limit the amount of impervious surface allowed on sites within a zoning district.

Chapter Name: This column records the chapter name of the code in question.

Section Number: This column lists the specific code reference number being analyzed. When section numbers are not used, this column can be used to indicate a page number.

Section Name: This column lists the specific code name being analyzed.

Description: This is used to summarize the relevant content of the code section as follows:

First paragraph - code summary,

Second paragraph - conditions or exceptions, and

Third paragraph - list specific indicators or standards.

The "Description" column can include either a synopsis of the language within the section, a paraphrase, or a quotation.

Discussion/Justification: Enter in this column a formatted response to two key questions: 1) what is the relationship between the source use or activity, the pathway, and the habitat? and, 2) what is the rationale for scoring this specific pathway for the following parameters: +/-/0, Magnitude, Duration, and Intensity?

Filter: This column provides a useful way to categorize the language used in the code section (Definite or Conditional, Quantifiable or Non- Quantifiable): *Definite* - an absolute and universal requirement, or *Conditional* - a requirement that applies only under certain circumstances or when certain conditions have been met; and either as, *Quantifiable* - a statement or regulation with a clearly measurable effect, or *Non-quantifiable* - a statement that would not result in a measurable effect.

Magnitude: This column documents the geographic extent or scope of the code section. Magnitude is classified as Citywide (Score=3), Reach (Score =2), or Point (Score=1). "Point" means in only one location or on a site-by-site basis. "Reach" means the extent is less than citywide but in more than one place.

Duration: Duration is a temporal measure of how often or how frequently the pathway occurs or how often a pathway persists. Duration is classified as "Chronic" (Score=3), "Episodic" (Score=2), or a single event occurring only "Once" (Score=1).

Intensity: Intensity is an estimate of the level of impact to stream habitat. Estimates of intensity are High (Score=3), Medium (Score =2), or Low (Score=1). "Low" means little long-term harm to habitat. "High" means certain long-term harm to habitat. "Medium" means moderate impacts to habitat are likely to result.

Area: This column is reserved for later use, when some of the pathways can be quantified.

Subtotal: This column is a subtotal of scoring for Magnitude, Duration, and Intensity.

Total: This column indicates the total score based on subtotal and Weight.

## CORVALLIS PATHWAYS AND REHABILITATION EVALUATION

This methodology has two parts. Part I sets the stage for the evaluation of impacts and the appropriate rehabilitation methods by using a more detailed assessment of the stream systems from a geographic and geomorphic standpoint. It uses an understanding of the urban setting of the stream basins, their function within the human-based infrastructure of the city, and the current habitat-forming processes to set the baseline for the last part.

Part II builds upon the scoring methodology developed in Phase 1 Pathways Analysis to provide the City with a tool for assessing the various options available for protecting, rehabilitating, and/or enhancing the current stream environment. This tool functions at the reach, stream, and watershed scales. This will eventually lead to the establishment of a trajectory of change toward achieving properly functioning condition within an urban stream network.

### Quantification/Calculation Factors

The following stepped approach was used for the quantification/calculation for evaluating each reach for chinook salmon habitat.

1. Determine the stormwater basin for each area of interest. Using the basins listed below to organize the classification makes sense, in that the inputs to the streams fit into this model better than a strictly watershed-based system. This approach recognizes the urban reality of Corvallis' stream systems, and allows the classification to link the elements of the Stormwater Master Plan with the ESA baseline analysis conducted in Phase 1.

    a. Dixon Creek
    b. Dunawi Creek
    c. Jackson-Frazier-Village Green
    d. Sequoia
    e. Oak Creek
    f. Garfield
    g. Mary's River
    h. Willamette River

2. Select an appropriate reach (one of the three or more major subdivisions of the stream) and classify it using the geomorphic methodologies listed below. For the purposes of this analysis, the most important reach characteristic becomes simply the ability to define an area where processes appear to be acting in a similar fashion. Reaches are those used by the Salmon Response Plan to assess habitat. These reaches are based on geomorphologic changes such as the presence of tributaries entering the main stem and gradient

3. Determine the related land use/zoning for the area in question. This characteristic will guide the assessment of the impacts of the various pathways, and accentuate those that may have the most impact and eliminate those that may not have an effect. This also provides a structure for both restoration and for the use of best management practices (BMP). Zoning, for the purposes of the Salmon Response Plan, may be kept at a more coarse scale. A great many of the effects detected in the analysis conducted in Phase 1 are citywide in their scope, and so may be dealt with, for the purposes of this Plan, at this greater scale. The NOAA Fisheries is unlikely to want to evaluate City activities at a scale smaller than the reach level, with the exception of easily identified point sources. The tool being developed will provide the City with the framework for assessing impacts at the point source level, if desired.

    a. Residential
    b. Agricultural
    c. Commercial
    d. Municipal
    e. Industrial

4. Determine listed fish use. This establishes the baseline for evaluation of the impacts of pathways on listed populations, and also provides input into the rehabilitation decision tree elements of the plan. Habitat types of interest include spawning habitat, rearing habitat, refugia, and movement corridors. Spawning habitats generally consist of riffle or pool tail-out areas with a high percentage of gravel substrate. Rearing habitat consists of moderate-sized pools with overhead cover. Barriers include impassable culverts, pop-up or other dams, and de-watered areas. Other elements of habitat directly influenced by city activities include temperature, turbidity, and food supply.

    a. Spawning. Depth, velocity, and size of redd area are highly variable. The key requirement is large gravel. Chinook have been known to clean and spawn in areas containing as much as 25% fine sand/silt/clay substrates.

    b. Rearing. Rearing generally occurs in smaller tributaries, using well-developed riffle-pool systems with rubble type habitat. Chinook tend to avoid rearing in beaver ponds or off-channel sloughs.

    c. Movement. The key element in movement is to ensure passage at times when listed species may be using a stream. Blockage factors include direct blockages such as pop-up dams and compromised or poorly designed culverts.

    d. Refuge from high-water winter flows. Access and water quality comprise the critical issues here.

5. Identify any habitat-forming processes in stream.

    a. Floodplain/groundwater connectivity (level of incision and overland flow). Does the stream still overflow its banks? Are there streamside wetlands present? Is there still a connection with the groundwater system, both laterally and vertically?

    b. Hydrograph. Do 2-year floods occur with a 1.5- to 3-year periodicity? Is the major contributor to year-round flows groundwater-based, such that the rising limb of the hydrograph is smaller than would be the case if the major contribution came from directed flow or overland flow? What level of floodplain water storage is available?

    c. Riparian community structure, width, and connectivity. Communities should be dominated by native species and should be a mosaic of the various seral stages and sizes appropriate for that area. Indications of non-functioning or impaired functioning include: riparian areas missing entirely or broken up by large areas of infrastructure impingement; communities heavily dominated by non-native vegetation and climax or early seral stages (should be a mosaic which would adequately represent levels of disturbance necessary to maintain the stream in a dynamic equilibrium); reduced or no capability for large wood supply to the stream, and leafy debris in the upper reaches.

d. Pool-riffle ratios, reach-specific. Existing pools should be deep and broken up by riffle areas, rather than taking on the form of glides. The presence of glides suggests a system that is on a trajectory away from properly functioning condition.

e. Substrate type. This depends upon the soils and bedrock present. Some reaches degrade more rapidly than others (i.e., reaches higher up in the system with greater gradients), and so contain larger substrates. Fines should dominate aggrading reaches, lower down in the system with little or no gradient. Fines dominate not properly functioning systems. When gravels are present, they are heavily imbedded or low in the system, indicating high flows sufficient to transport bedload.

f. Instream cover. –The presence of undercut banks, instream boulders, and woody debris.

## SCORING AND RANKING METHODOLOGY

The following is the description of the pathway/effects analysis used to determine the impact of city services and citizen behavior on chinook salmon habitat. The first part is the development of the pathways/effects database in the first phase of the project. The second part is the combining of the baseline conditions data and pathways/effects database in the second phase of the project into a powerful tool that allows the City to identify the geographic distribution and the degree of impact that City services and citizen behavior have on chinook salmon habitat. This weighted database was developed using relational database software, which can access, query and analyze large data sets (the weighted dataset has approximately 4,300 records). From this weighted database the City is able to rank impacts to chinook salmon habitat and develop a list of priority remedial actions.

Pathways/effects weighted database covers the following activities and citizen behavior:

- Public infrastructure activities and operations and maintenance
  - Wastewater treatment
  - Water supply
  - Stormwater management
- Transportation activities and routine road maintenance
- Planning activities
  - Comprehensive Plan
  - Zoning
  - Land Development Code
- Parks and recreation activities and operations and maintenance
- Fire Department training and vehicle/equipment maintenance

- Public construction specifications
- Citizen behavior (household and yard maintenance activities, landscaping, home auto repair, etc.)

**Scoring process**

Priority ranking of City programs and activities was based on the scores as discussed above. Using the stormwater basin for each area of interest recognized the urban reality of Corvallis' stream systems. Using reaches as defined by the riparian analysis recognized the changes in streams resulting from urbanization and solves the problem of reach definition characteristics. For the purposes of this analysis, the most important reach characteristic becomes simply the ability to define an area where processes appear to be acting in a similar fashion.

The use of a methodology for scoring impacts and evaluating projects allowed the City to make determinations as to the most important elements to fulfill its various mandates (e.g., ESA, Clean Water Act, Statewide Planning Goals). This methodology assumed that funds for rehabilitation are not limitless, and there is a desire to accomplish the necessary ordinance changes in as few steps as possible. The approach provided a mechanism for evaluating effects on any level desired by the City, as well as erecting a framework for fiscal analysis.

**Pathways/Effects Analytic Approach**

1. Determine the pathway(s) of interest and operating in the selected area. For the City of Corvallis, Contaminants and Buffers are the major pathways for habitat degradation in all reaches and all systems for the purpose of ESA compliance. The following are the pathways (see detailed discussion in earlier part of this chapter).

    a. Channelization/Instream Habitat

    b. Impervious Surface

    c. Riparian Areas/Buffers

    d. Barriers

    e. Contaminants

2. Determine the latitudinal/longitudinal extent of the pathway.

    a. Within the riparian buffer/floodplain (3). Activities occurring within this zone have the capability of influencing the listed fish and their habitat with less need for a transport mechanism such as the stormwater system. Activities within this area also directly affect the riparian buffer characteristics.

   b. Outside the buffer/floodplain (1). This is scored lower simply because activities occurring outside the buffer require the intervention of a transport mechanism (such as the stormwater system).

3. Rank the location of the pathway or event (by reach and stormwater basin). Each system should be weighted according to the pathway of interest. The Contaminant pathway should be the same for all streams, regardless of their position in the system, as should the riparian buffer (for purposes of water quality). Impervious surface and instream habitat should use the ranking system listed below. The importance of the Buffer pathway varies with the desired function. The most important functions of the buffer are to maintain water quality. Buffer width should increase in a downstream direction, as the amount of flow increases and the gradient decreases to the point that the stream can easily overflow its banks. Barriers should be addressed going upstream, with the greatest emphasis on those lower in the system.

   a. Upland tributaries: urbanized (4), non-urbanized (5)
      i. Intermittent stream area (2)
      ii. Perennial stream area (4)
   b. Non-urbanized lowlands (2)
   c. Urbanized lowlands (1)

4. Determine the spatial extent (magnitude) of the pathway's influence. Spatial extent plays an important role not only in the assessment of the level of influence, but also on the nature of the restorative or rehabilitative activity. The greater the magnitude, the more likely that fixes will require some change in ordinances or the creation of new ones. This does not preclude the use of individual or point-related BMP.

   a. Point. Occurring at a single location or site (1).
   b. Reach. Occurring at multiple locations throughout the designated stormwater reach (2).
   c. Reach. Occurring at multiple locations throughout the designated ESA survey reach (3)
   d. Basin/Watershed. Occurring throughout the basin as a whole (4).

5. Determine the timing (Duration) of the pathway. Timing has considerable influence upon the resilience of the system. Historic habitat-forming processes tended to be single-event or episodic in nature. The chronic nature of a great many anthropogenic changes in inputs to these processes is considered to apply more stress to the ability of the system to rebound.

   a. Single event (1) - occurs as the result of failure to implement BMPs or failure of BMPs.

b. Episodic (2) - intervals are regular but occurs more than once

c. Chronic (4) - occurs as the result of long-term action (e.g. stormwater runoff

d. Periodic (3) - occurs at regular intervals

6. Determine intensity of the pathway or event. Intensity of an activity is related, to some degree, to the previous two categories (magnitude and duration) and has the least clear-cut predictive capability.

   a. Low (1) - little or no mortality or habitat change expected

   b. Medium (2) - some mortality; habitat changes occur but are within the resilience capability of the stream and within expectations for that particular time period in the evolution of the stream

   c. High (4) - dramatic changes beyond the capability of the reach or stream to accommodate, forcing a change in steam geomorphology beyond that which could be expected from typical stream evolution; sufficient mortality to put populations in that area in jeopardy

The scoring methodology determines the pathway(s) of interest and operating in that area and the latitudinal/longitudinal extent of the pathway. It is then assessed as to its position within or outside the riparian buffer/floodplain, and ranked by the location of the pathway or event (by reach and basin). Next, it evaluates instream habitat and presence of impervious surface by reach longitudinal position and physiographic characteristics. Finally, it evaluates the spatial extent (magnitude, duration, and intensity) of the pathway's influence.

# CHAPTER 5. BASELINE CONDITIONS

## INTRODUCTION

The purpose of this chapter is to present an overview of the baseline conditions for Chinook salmon habitat. This covers the data collected and evaluated in Phase One of the project (see *Baseline Habitat Evaluation and Evaluation of the Impacts of City Activities*, February 2002) and the technical memorandum titled *Description of Habitat for Upper Willamette River Spring Chinook ESU* (March 3, 2003). The stream and river reaches identified in the baseline descriptions are displayed in Figure 3 (Chapter 3).

**Dixon Creek (From Corvallis Stormwater Master Plan, 2000)**

Dixon Creek originates in the hills to the northwest of Corvallis. Most of its length lies within the City, where it is an important feature of many residential backyards. It also runs through several school properties and parks before reaching commercial property at 9th Street and Reiman Avenue and shortly thereafter, the Willamette River. The Dixon Creek watershed contains 2,712 acres. The largest land use is low-density residential, which covers more than one-third of the watershed. In addition, medium density residential, OSU forest (McDonald-Dunn Forest) land, and vacant parcels each cover approximately 400 acres. Estimated current impervious surface coverage is 897 acres, which is approximately 33% of total watershed acreage

If the watershed is developed to full build-out according to the City of Corvallis' Comprehensive Plan (1998), the current vacant land may be largely converted into low- and high-density residential use. Other changes may also include a decrease in medium-density residential and an increase in commercial land use. Overall, the number of impervious acres is estimated to increase by 13%, from the current 897 acres to 1,017 acres, or nearly 38% of the watershed acreage.

The following habitat evaluations summarize the information from the Streamwalks conducted by Watershed Applications and field analyses conducted by the ESA project team.

*Temperature*

The City is evaluating temperature at four permanent monitoring sites in Dixon Creek. Thermistors at the sites record the water temperature hourly.

*Sediment/Turbidity*

The high levels of fine sediment found throughout the Dixon Creek watershed are likely a function of the local geology and urbanization. In the vicinity of Dixon Creek, the Willamette valley floor is composed nearly entirely of silty-loam soils. Therefore, high levels of fine and suspended sediments are likely natural features of the stream. Stream incision and bank erosion likely have added to the natural loads of fine and suspended sediments. Nutrient inputs from urban landscaping and fertilizing likely have increased the amount of algae in the stream and contributed to higher turbidity levels.

*Chemical and Nutrient Contamination*

The U.S. Geological Survey (USGS) assessed Dixon Creek during its sampling in the mid-1990s. The chemicals found in it placed it in the non-agricultural chemical source category. These included Carbaryl (Sevin), used for both home and landscape applications; Dichlobenil (Casoron) and Tebuthiuron, used to control broadleaf weeds and applied under asphalt and on railway rights-of-way (ROW); Diazinon, whose use is similar to Carbaryl; and Prometon, which is used in urban landscaping, ROW, and industrial applications, and by homeowners. Dixon Creek also exceeded standards for temperature, fecal coliform, and *E. coli* bacteria. It appeared to have no excessive nutrients. This stream likely carries the "usual" urban runoff components of metals and petroleum products.

*Physical Barriers*

A partial barrier exists at the confluence of Dixon Creek and the Willamette River. The box culvert under Highway 20 has been modified to promote fish passage by creating deeper, slower flows through a portion of the culvert. However, because the culvert is perched and falls onto riprap, access to the culvert's fishway is restricted to times when the water level in the Willamette reaches the culvert outfall (mainly during winter and spring flows).

Flat-bottomed box culverts located at 3$^{rd}$ Street, 4$^{th}$ Street, Buchanan Avenue, Kings Boulevard, 29$^{th}$ Street, and Walnut Boulevard may pose additional passage problems during high and low flows. Dace were observed in the stream up to 29$^{th}$ Street, indicating that all of these box culverts are likely passable during some flow conditions.

*Substrate*

Exposed clay layers, silt, and riprap are the most common substrates in Dixon Creek. The high levels of silt and lack of gravel are likely a function of the local geology. No rock outcroppings or colluvial debris slides occur in the watershed to serve as a source of coarse stream sediments. Moreover, the silt loam soils that dominate this area of the Willamette valley (USDA 1975) are likely the dominant streambed material in the small wetland channels that historically occurred in the Corvallis area. The exposed clay substrate likely results from urbanization along Dixon Creek. Channelization and changes to the creek's hydrograph have led to increased downcutting of the streambed and the exposure of clay layers formerly covered by the more erodible silt soils. The large quantities of riprap in the channel result from the frequent bank stabilization efforts needed to protect the highly erodible streambanks.

*Large Wood (LW)*

The small amount of LW in Dixon Creek does not contribute significantly to stream complexity or aquatic refuge and represents a distinct change from the high amounts expected, historically. Most of the wood in the creek consists of small-diameter deciduous logs that decay rapidly and have little potential to create significant instream cover. The highest concentrations of LW are in the small headwater streams of Dixon Creek where fish presence is unlikely, as is downstream transport of the LW. Future LW recruitment potential is limited by the reduced size of the riparian zones and channel incision.

*Pool Frequency*

Trench scour pools, with long glide-like tail-outs, were the dominant habitat types in reaches of Dixon Creek that could potentially support salmonids. However, pool frequency does not meet the standard established by NOAA Fisheries. The long pool lengths precluded sufficient numbers of pools from occurring in any 1.6 km length of stream.

*Pool Quality*

Pool quality in Dixon Creek is poor. Deep scour or trench pools are abundant in Dixon Creek; however, they lack structure such as LW and undercut banks that provide cover for fish. Reduction of pool depth because of sediment deposition is not a concern in Dixon Creek. The channelized nature of the stream ensures that all deposited sediments are washed out of the system during high flow events.

*Off-Channel Habitat*

Channel entrenchment in the lower reaches of Dixon Creek precludes the formation of off-channel habitat. No off-channel habitat exists in stream reaches along the mainstem of Dixon Creek or the lower portions of the tributary streams.

*Refugia*

Dixon Creek was likely bordered by upland gallery forests and lowland prairies before settlement by Euro-Americans. Land conversion and urbanization have dramatically changed the nature of the stream and its riparian areas. While a small amount of remnant aquatic refugia may exist in the headwater streams, none was observed during the survey. The natural wetland channels have been converted to a single entrenched channel. Gallery forests and riparian wetlands have been replaced with residential developments. Riparian buffers are narrow and have been overrun by invasive species such as Himalayan blackberry (*Rubus discolor*) and bedstraw (*Galium* sp.).

*Width-to-depth Ratio*

Width-to-depth ratio is estimated to be approximately 8, and meets the NOAA Fisheries criteria for PFC. However, because the channel is entrenched and revetments often prevent the stream from widening, this indicator may not be appropriate for use in evaluating stream health. This relatively low width-to-depth ratio likely results from urbanization than preservation of natural habitat conditions. Habitat features usually associated with low width-to-depth ratios, such as lower stream temperatures and instream cover, are not characteristic of the current conditions in Dixon Creek.

*Streambank Condition*

The conditions of streambanks in Dixon Creek are variable. Root masses of living trees are being undercut by the stream and bank erosion is common in the upper watershed. In areas where root masses are being undercut, future bank erosion is likely as the trees fall and expose unstabilized soils. Large portions of the streambanks have been armored with riprap, gabions, and log bulkheads. As more impervious surface is added to the watershed, bank erosion and undercutting will likely increase.

*Floodplain Connectivity*

Channel incision has severed much of the natural hydrologic link between the floodplain and the stream channel. Incision depth in the mainstem of Dixon Creek averages approximately 2.5 m. Any flows that once may have regularly exceeded the streambanks and inundated the floodplain are now confined to the entrenched channel. Overbank flooding now occurs only during extreme runoff events. Wetland riparian areas that once bordered the creek have become perched and drained as the water table has deepened.

*Peak and Base Flows*

Peak and base flows undoubtedly have been altered by the loss of riparian wetlands, channel incision, land conversion, and the addition of large amounts of impervious surface to the watershed. The loss of floodplain wetlands caused by historic and present-day channel incision decrease the watershed's capacity to store water and likely has resulted in decreased base flows. Channel incision has increased the conveyance capability in the watershed and contributed to sharper peaks in the stream hydrograph. The addition of large amounts of impervious surface, coupled with stormwater conveyance systems, creates a pathway by which precipitation is collected and quickly piped to the stream rather than percolating into the groundwater or slowly trickling into the stream. This rapid transformation of precipitation to runoff creates unnaturally high and sharp spikes in the hydrograph of Dixon Creek.

*Road Density and Location*

Road density in the urban environment of Dixon Creek is very high. A significant portion of the watershed is covered with impervious surface. Roads closely parallel the stream in many places and numerous road crossings fragment the aquatic and riparian habitat.

*Disturbance History*

More than 60% of the Dixon Creek watershed has been developed for commercial or residential purposes. Very little late successional or old growth forest remains in the area. Because of the permanent nature of urban development, no significant improvements to this indicator are expected.

*Riparian Reserves*

Approximately 80% of the riparian area in the watershed is developed. Riparian vegetation in the developed areas is confined to the land at or below the top of bank. At least 33 road crossings occur on Dixon Creek. These crossings reduce the connectivity and create a discontinuous series of isolated riparian areas.

**Dunawi Creek (From Corvallis Stormwater Master Plan, 2000)**

Dunawi Creek runs from Bald Hill Park west of Corvallis eastward to its conjunction with the Mary's River at Brooklane Drive. The Dunawi Creek watershed contains 2,363 acres. The largest land uses in the watershed are low-density residential (766 acres) and vacant land (609 acres). Some land in the watershed is used for industry and commerce, although this is mostly limited to the Sunset Research Park and along Philomath Boulevard (Highway 20/34). If the watershed is developed according to the City of Corvallis' Comprehensive Plan (1998), all of the vacant land may be developed, with most of it converted to residential use. In addition, medium- and high-density dwellings will make up an increasingly larger portion of the residential land use. As a result of these changes, the amount of impervious surface could increase from 762 to 968 acres, an increase of 27%.

*Temperature*

Temperature was not assessed because the survey period did not overlap with the summer months when stream temperatures are of greatest concern. The City of Corvallis currently is conducting a temperature assessment.

*Sediment/Turbidity*

Dunawi Creek contains high levels of fine sediment. Silt, sand, and organic matter are the most common substrates. The water in the creek had low visibility at the time of survey. The high level of fine sediment and turbid nature of the water likely are caused by the wetlands in the watershed and the presence of the predominant substrates (clays and other fine sediments). The slow, flat nature of the watershed allows for accumulation and decomposition of organic material, as well as benthic algae blooms. The high color of the creek is likely caused by tannic acid or other solutes produced by decomposing organic material.

*Chemical Contamination*

The urban chemicals that may be present in this basin are the same as those potentially present in Dixon Creek.

*Physical Barriers*

A retaining wall just upstream from the confluence of Dunawi Creek and the Mary's River creates a 1-meter drop that creates a barrier to Chinook salmon fish passage. The height of the falls and the lack of a plunge pool below it eliminates fish migration from the Mary's River into the Dunawi Creek watershed. Reconstructing the retaining wall to make it passable to Chinook salmon would have limited benefits because of the poor quality of upstream salmonid habitat.

*Substrate*

Clay, silt, sand, and organic materials dominate the substrate in Dunawi Creek. The natural geology of the watershed, as opposed to the human disturbance, likely is the cause of the high level of fine sediment. Coarse substrates other than riprap were not found in significant quantities in any portion of the watershed and appear to be absent from all alluvial layers exposed by the stream. Moreover, the flat topography of the watershed does not create enough stream energy to produce the downcutting needed to expose sources of coarse sediment or transport such sediment once it has been exposed. Without a source of gravel and cobble substrates, Dunawi Creek appears always to have been devoid of coarse substrates.

*Large Wood*

LW is scarce in the Dunawi Creek drainage. No pieces that match the NOAA Fisheries definition of 24-inch diameter and 5-foot length were observed in the stream channel. Small accumulations of woody debris are common in many reaches. Because of the small size of Dunawi Creek and the low energy of the flows, these accumulations are able to persist within the active channel, functioning similarly to pieces of LW. These accumulations create small pockets of scour and could provide cover to any fish that potentially inhabit the creek.

*Pool Frequency and Pool Quality*

Pool frequency and pool quality are very poor. Aquatic habitat is largely composed of slowly moving, slack-water glides. Riffles are short and infrequent. Pools with significant scour are even more infrequent. The one wide pool is present in Reach 2, which results from a relatively large debris jam.

*Off-Channel Habitat*

The pond near the top of the south fork and the millpond on the north fork (both artificial situations) are the only two significant areas of off-channel habitat.

*Refugia*

Intact, well-buffered riparian areas exist in few areas of the Dunawi Creek watershed. Residential and commercial developments, city parks, and agricultural fields all encroach into Dunawi Creek riparian areas. This disturbance to riparian habitat has aided the invasion of species such as reed canarygrass (*Phalaris arundinacea*) and Himalayan blackberry. Approximately 33% of the total stream habitat has been straightened and channelized. In other areas, the channel appears to have been excavated for the purpose of enhancing stream conveyance. Encroachments into the riparian areas and channel modification limit the amount of suitable habitat available to sensitive aquatic species.

*Width-to-depth Ratio*

The width-to-depth ratio in Dunawi Creek is less than 10. The glide-like streambed common in the creek averages approximately 0.15 to 0.2 m in depth. The channel width averages about 1.5 m across.

*Streambank Condition*

Bank erosion in Dunawi Creek is uncommon. Eroding banks are present in small areas of Reach 2 and the upper portion of Reach 3. The erosion in Reach 3 is just below the stormwater outfalls and box culverts located at 35$^{th}$ Street, where large sections of the bank are collapsing into the creek. In other portions of the creek, low stream gradients do not appear to generate enough energy to undermine rooted vegetation and erode bank substrates. Streambank conditions in the Dunawi Creek watershed appear stable, with little evidence of erosion.

*Floodplain Connectivity*

With the exception of the channelized portions of Dunawi Creek (approximately one-third of the watershed) most of the stream regularly exceeds its banks and inundates the local floodplains. Evidence of ephemeral side channels is apparent in many wetland riparian areas.

*Changes in Peak and Base Flow*

Some changes in peak and base flow likely have occurred as a result of channelizing and increasing impervious surface. Approximately 33% of the channel has been straightened or confined within artificial banks. These channelized stream segments have a reduced capacity to detain flows during peak runoff events, and have little water storage potential. The increase in impervious surface creates quicker, higher spikes in runoff after rainfall events. The magnitude of the changes has not been quantified; however, based on instream indicators such as increased frequency of erosion and channel downcutting, the hydrologic changes associated with development have not been great enough to produce large changes in the channel morphology. The extent to which summertime flows have been altered because of decreased storage capacity has not been evaluated.

*Disturbance History*

Dunawi Creek is an urbanized stream. Nearby forest clearing, development, and agriculture have disturbed the entire watershed. Very little mature forest exists in the watershed.

*Riparian Reserves*

Riparian corridors and setbacks have been established along much of Dunawi Creek. These vary in width from a few meters to nearly 100 meters. In corridor areas, near Technology Loop for example, reestablishment of native riparian vegetation appears to be impaired by invasive species. Overstory trees do not appear to be recolonizing these areas, and riparian shading and function have been lost. Many of the undisturbed riparian areas are functioning in a limited capacity. The overstory in these areas provides good canopy closure and shade to the channel. However, invasive species such as Himalayan blackberry and reed canarygrass are colonizing many areas.

**Oak Creek (From Corvallis Stormwater Master Plan, 2000)**

The Oak Creek Watershed is the largest watershed within the study area of this plan. The upper reaches of Oak Creek lie outside the city limits and the UGB. The stream's headwaters are located northwest of Corvallis in McDonald State Forest, on the southern slopes of Cardwell Hill at about 747 meters in elevation. Oak Creek follows logging roads southward past Dimple Hill and the OSU Experimental Station. The creek follows Oak Creek Drive, where it is joined by Alder Creek downstream from Skillings Drive. Mulkey Creek joins Oak Creek from the west, downstream from Bald Hill Park. Oak Creek flows under 53$^{rd}$ Street just north of Harrison Boulevard.

The lower reaches begin just outside the UGB beginning where Oak Creek crosses Harrison Boulevard to the south and then crosses into the city limits. The stream then flows southeast toward OSU. It flows through pastures, farm buildings, and research facilities before reaching the main body of the campus. On the south side of the OSU campus, the creek is bounded by the Reser Stadium parking lot to the northeast and mixed residential use to the southwest. As Oak Creek leaves OSU, it flows through a short residential section before flowing under Highway 20/34 and entering Mary's River.

The Oak Creek watershed contains 8,300 acres. The largest land use type is McDonald-Dunn state forest (managed by Oregon State University), which covers almost 5,900 acres, representing more than 70% of the watershed. Approximately 12% of the watershed (1,030 acres) is used for agricultural purposes. OSU manages both the forestland and most of the agricultural land. With the addition of the campus itself, OSU manages almost 90% of the land in the watershed. More than 500 acres are listed as undeveloped.

Under future development, the undeveloped land may be built out as residential and some of the OSU agricultural land may be developed for university non-agricultural purposes. The amount of impervious surface in the watershed will increase only slightly under these conditions.

*Temperature*

The City is assessing temperature regimes in the stream.

*Sediment/Turbidity*

High, fine sediment loads and turbidity are likely natural features of the Oak Creek drainage. The banks of the creek are composed of alluvial soils that are easily eroded and suspended in the water column. Because of its low gradient (less than 1% slope), the stream often lacks the velocity to transport eroded fine sediment out of the drainage. Instead, it settles out in areas with lower velocities. The naturally occurring high level of turbidity and fine sediment in Oak Creek have likely been augmented with fine sediment loads brought about by human activity. Many portions of the upper watershed have been logged, with historic practices likely contributing fine sediment to the stream. Agricultural fertilizers and manure undoubtedly have leached into the stream, increasing the amount of algae in the water and leading to high turbidity.

*Chemical Nutrient Bacteria Contamination*

Data collected by the City indicates that concentrations of *E. coli* bacteria in Oak Creek exceed the Oregon Department of Environmental Quality's (DEQ) standard of 126 organisms per 100 milliliters of water. The urban chemicals that may be present in this basin are the same as those potentially present in Dixon Creek. Some agricultural chemicals such as atrazine and related compounds may also be found in Oak Creek.

*Physical Barriers*

The concrete exit skirt of the twin box culverts at the Highway 20 creek crossing creates a barrier falls. The incision downstream has deepened since construction of the culverts and left the exit apron perched approximately 1 meter. No adequate jumping pools exist immediately below the perched apron. Although the falls created by the culverts appears impassable at all times of the year, juvenile Chinook salmon have been observed upstream from the barrier as recently as 1994. The pop-up dam near the top of Reach 3 creates a second fish passage barrier. The dam is used by OSU to create a pool for irrigation withdrawals and is therefore only in place during the dry season (May through October).

*Substrate*

Gravel dominates the substrate in the mainstem of Oak Creek; however, silt, sand, bedrock, and native clay layers are also common substrate components. Observed gravel substrates were almost always embedded in sand and silt that clogged interstitial spaces and restricted flows through the substrate. Estimates of embeddedness in mainstem reaches decreased from 50% in the lower two reaches to between 20% and 30% in Reach 3.

Silts and other fine sediments dominated substrates in the tributary streams. These small streams appear to lack a source of coarse substrate and have insufficient energy to transport and distribute such substrates. The high level of fine sediment in these streams is more a function of the surrounding geology and hydrologic state of the streams than any human habitat alterations.

*Large Wood*

The concentration of LW in the watershed is estimated to be approximately 87 pieces per kilometer. The NOAA Fisheries standard for PFC is 80 pieces of LW per 1.6 km; defined as 60 cm in diameter and at least 15 m long. In the survey, woody debris was counted as LW if it was 10 cm in diameter and 3 meters long. Because very few pieces of woody debris counted in Oak Creek would meet the NOAA Fisheries criteria, concentrations of LW do not meet the NOAA Fisheries standard for PFC.

Downed trees contribute little habitat in the lower reaches of the creek. While concentrations of LW are more substantial in Reaches 2 and 3, they do not approach the amount of LW that historically occurred in the creek. At current levels, LW does not contribute significantly to habitat complexity and only rarely creates deep sheltering pools important for salmonid rearing.

*Pool Frequency*

Pool frequency may not be an appropriate indicator for evaluating the aquatic habitat in Oak Creek. Because of its low gradient, the creek contains an abundance of pool habitat. These pools are often extensive (one measured 64 meters in length) and contain long glide-like tail-outs. The length of many pools limits the frequency with which they occur.

*Pool Quality*

Pool quality in lower Oak Creek tends to be poor. Most pools are less than 1 meter deep and frequently lack objects such as LW or boulders that provide instream cover and shelter from high stream flows. The most common form of cover in the creek is undercut living root wads. These provide fish with hiding places for predator avoidance but may not be suitable for shelter from fast current during high flow events. With the exception of the one large debris jam in Reach 3, LW in the creek at the time of the survey did not provide significant sheltering areas that juvenile salmonids would use to avoid high wintertime flows.

*Off-Channel Habitat*

The deep and narrow incision of the creek offers little opportunity for development of off-channel habitat. Important slack-water features such as side channels, oxbows, and large root wads are absent or rare in Oak Creek. With few structures to deflect the current and no floodplain to disperse the energy of the stream, fish have few places to take refuge from the high flows that fill the incised channel. Many are likely washed out of the drainage during high flow events.

*Refugia*

Historically Oak Creek was a sinuous stream likely bordered by floodplain wetlands, prairies, and gallery woodlands. Euro-American settlement of the area has resulted in stream channelization, riparian forest clearing, and wetland conversion (OSU 2001), although the lower reaches of Oak Creek now contain more riparian forest than historically. As a result of these activities, very little aquatic refugia still exists on Oak Creek. The deeply incised channel precludes formation of off-channel habitat and floodplain wetlands that are usually associated with refugia. The riparian corridor is narrow, often ending at or near the top of the streambank, and is insufficient to buffer any areas of refugia that may exist. Invasive species such as Himalayan blackberry and reed canarygrass are prominent species along many portions of the creek. As a result, very little remnant habitat for sensitive aquatic species exists in the watershed.

*Width-to-depth Ratio*

The width-to-depth ratio of Oak Creek was estimated to be less than 10. Channel incision prevents the channel from spreading out into shallow riffles or glides. The high proportion of pool habitat, especially in Reach 2, gives the stream consistently deep residual depths. Due to its low width-to-depth ratio the creek is less prone to temperature fluctuation. The relatively large volume of water in the channel may buffer the stream against rapid temperature increases during periods of high temperature in summer heat waves.

*Streambank Condition*

The surveyed portion of Reach 2 was the only surveyed area in Oak Creek in which more than 10% of the streambanks were eroding. Approximately 14% of the banks in the surveyed stretch of Reach 2 were eroding, whereas only 9% of the streambank in Reach 1 was eroding. Reach 3 had the lowest proportion of eroding bank with only 3% of the bank showing signs of active erosion. Bank erosion in the tributary streams was uncommon and was estimated to be well below the 10% threshold established by NOAA Fisheries as properly functioning.

The relatively low amount of bank erosion in such a highly disturbed watershed may be attributed to two factors. First, the bulk of channel incision probably occurred in the early part of the century as wetlands were drained and channels modified to create agricultural lands and development of the City of Corvallis. The channel may now be approaching a stage of equilibrium. The channel likely has carved away enough width and depth to accommodate its bankfull flows without eroding its banks. Second, the lower streambank in many portions of the creek is composed of clay layers and cemented alluvial materials that are only slightly erodible. These slightly erodible bank substrates likely slow the rate of erosion in many parts of the creek.

*Floodplain Connectivity*

Floodplain connectivity along Oak Creek may have degraded dramatically since the 1940s. Benner (1984) describes the Oak Creek channel near the current location of Reser Stadium as being braided as recently as 1936. The land near Oak Creek was described as "low, wet, and especially prone to flooding." By 1956 the channel continued its historic incising, further isolating the forest/prairie from the creek (Benner 1984). The increased channel incision also perched the riparian wetland above the streambed. Floodwaters inundated and recharged the riparian areas less frequently, the water table deepened, and the wetlands were converted to agricultural uses. Hyporheic connections between the stream and floodplain were severed as the channel began to erode into non-permeable clay layers and cemented alluvium.

In its current entrenched condition, the creek has little or no connectivity with its historical floodplain. The low terraces present in Reach 3 have created a new, narrow floodplain below the high terraces of the creek bed.

*Changes in Peak and Base Flow*

Changes in the peak and base flows of Oak Creek undoubtedly have resulted from channelization, deforestation, and wetland conversion. Channelization of Oak Creek has reduced the capacity of the stream to detain and store water during periods of high runoff. Spikes in discharge are generally greater in magnitude and shorter in duration than historically occurred. Loss of riparian wetlands has likewise reduced the watershed's capacity to store water and likely results in higher peak flows and lower base flows. Deforestation in the Oak Creek drainage also likely resulted in changes to the stream's hydrologic regime. Removal of vegetation from a watershed or changes in vegetated communities from communities with high rates of transpiration to communities with low rates of transpiration may result in higher magnitude peak flows (Brooks et al. 1991).

The precise nature of the changes to the hydrograph of Oak Creek is unknown. It is likely that current peak flows are greater than historical magnitudes because of channel incision, wetland conversion, urban development, and deforestation. Changes in base flow levels are difficult to evaluate because of the opposite and competing effects of deforestation and wetland conversion.

*Disturbance History*

Timber harvest and the conversion of land for agricultural and municipal purposes have disturbed much of the Oak Creek watershed. The headwaters of Oak Creek are in McDonald Experimental Forest, which has been extensively harvested. The Oak Creek valley between the experimental forest and the Willamette valley is a mosaic of private properties, with high levels of disturbance. Where the Oak Creek channel meets the Willamette valley, commercial, residential, and agricultural land uses have resulted in riparian degradation and loss of wetlands.

*Riparian Reserves*

The riparian areas along Oak Creek are highly fragmented, narrow bands of vegetation that often inadequately shade the stream channel. The riparian vegetation along much of the creek is restricted to the area between the edge of the stream and the top of the bank. Although stream shading in these areas is sometimes adequate, gaps in the canopy occur in many places, leaving the channel exposed to solar heating. The lack of a riparian buffer in these areas also decreases the potential for LW recruitment into Oak Creek.

In areas where the riparian vegetation extends beyond the top of bank, it is often limited to 10 or 15 meters beyond the top of bank. Stream shading in these areas is generally better than in stream segments with narrower riparian zones, but the lack of a floodplain and riparian wetlands limit riparian functioning. Few large tracts of wide riparian areas exist in the watershed. Large tracts of native riparian forest occur near the covered bridge and bike path crossing in Reach 3, and along the Bald Hill tributary. These areas contain remnants of the gallery forests and riparian wetlands that were once common along the stream.

**Sequoia Creek (From Corvallis Stormwater Master Plan, 2000)**

The Sequoia Creek headwaters originate near Chip Ross Park. The creek runs generally southeast through residential development then turns eastward near Sycamore Avenue. The creek crosses beneath Highway 99W and the Willamette and Pacific Railroad trestle before turning to the northwest at its junction with Village Green Creek. After being joined by Village Green Creek, Sequoia Creek turns eastward, where it is known as Stewart Slough. The creek crosses beneath Highway 20 and ultimately discharges into the Willamette River.

The Sequoia Creek Watershed contains 1,357 acres. The largest land use at present is low-density residential, which covers approximately 34% of the watershed. Fourteen percent of current use is for medium- and high-density residential. City streets and rights-of-way take up approximately 14% of the available area. Approximately 12% of the land use is industrial, primarily located downstream of Highway 99W. Open spaces make up about 11% of the watershed. Land use in the remaining areas of the watershed includes a mixture of commercial properties, OSU, and vacant land.

As future development occurs, the vacant land may be converted to low-, medium- and high-density residential areas. Other changes may include a decrease in industrial land-use and an increase in commercial use. The number of acres of impervious land will increase from 543 acres to 650 acres (29% increase in impervious surface), thus affecting the quantity and quality of stormwater runoff in the watershed.

*Watershed Findings (From Corvallis Stormwater Master Plan, 2000)*

The condition of the watershed was evaluated using information from a number of sources, including public comments collected at open houses, City of Corvallis (City) staff input on maintenance and operation issues, a technical stream evaluation of selected reaches, and modeling the stormwater conveyance system for existing and future build-out scenarios.

The elevation of the channel drops quickly relative to the horizontal distance, thus defining a steep gradient upstream of Walnut Boulevard. The gradient flattens out below that point, creating the potential for flooding in the transitional area between the hills and the flat area near the mouth of the creek. The gradient is very flat downstream of 9th Street, thereby increasing the potential for flooding during large storm events.

Riparian conditions vary along the length of the stream. Unlike those of other Corvallis streams, the riparian corridors of Sequoia Creek have more shrub area toward the downstream end. Industrial land-use encroaches on the creek near Jack London Street. Also, a large number of natural debris dams in the creek downstream of Jack London Street obstruct flows. An example of industrial land-use encroaching on the stream occurs at the recycling facility (Corvallis Disposal) located along the north bank of the creek downstream of Highway 99W. Sediment accumulation at the culverts under 9th Street may restrict higher flows.

**Mary's River (From Corvallis Stormwater Master Plan, 2000)**

The Mary's River watershed portion of this planning effort contains three small drainages that lie south of the Corvallis Country Club. The drainages lie outside the city limits, but inside the UGB. Flows from the drainages run southward underneath Brooklane Drive before entering the Mary's River floodplain. The 78 acres of drainages were modeled from the culverts underneath Brooklane Drive to the top of their drainages at the crest of the hill. The existing land use is split between low-density residential and open space, but the area is undergoing significant development. In the future, low-density residential will cover 69 acres, with the rest preserved with an open space conservation designation. Another subdivision, Brooklane Estates, also is being constructed further to the east in the Mary's River watershed. Brooklane Estates is located south of the Oak Lawn Memorial Park and has its own piped drainage system. This subdivision was not examined in detail or modeled, but is included for the sake of completeness.

*Temperature*

The Mary's River is listed on the DEQ's 303(d) list for temperature exceeding the 64°F (17.8° C) standard for rearing salmonids. Temperatures exceed the standard on a yearly basis and have been recorded as high as 82.4° F (DEQ 2001).

*Chemical/Nutrient Contamination*

The Mary's River is listed on the DEQ's 303 (d) list of water-quality limited bodies for bacterial contamination. Fecal coliform levels exceeded state standards in 24% of the samples taken. The Mary's River also contains some levels of atrazine compounds according to the USGS.

*Sediment/Turbidity*

The Mary's River is turbid and has a high level of fine sediments. Visibility at moderate to low flows was approximately 0.6 m. (2 ft.). Fine sediments are the dominant substrate types. The turbidity and high level of fine sediments is a function of the local geology and land usage. The soft, loamy soils that dominate the banks of the river are easily eroded and suspended in the water column. Deforestation of riparian areas and headwater streams also likely contribute to high levels of suspended sediment. Turbidity also may be affected by increases in nutrient levels from agricultural fertilizers. Increased phosphorous and nitrogen levels will lead to increased concentrations of free-floating algae.

*Physical Barriers*

No potential barriers to fish passage occur in the surveyed reach of the Mary's River.

*Substrate*

In areas where the river was shallow enough to assess the substrate, sand and fine sediments or gravel were dominant. However, a layer of non-erodible, cement-like alluvium is also common on the channel bottom.

*Large Wood*

Fifty-four individual pieces of LW, 16 accumulations, and 10 jams were present in the portion of Mary's River within the UGB. Many of these create small back eddies that would provide refuge during high flows.

*Pool Frequency*

Pool or pool-like run habitat comprises more than 95% of the habitat in the Mary's River. The scarcity of riffle habitat and abundance of slack water habitat may limit salmonid use of the river. Riffles are important in creating foraging opportunities for salmonids, and the lack of such habitat may decrease its suitability as habitat for these species. Therefore, the high amount of pool and slack water habitat in the Mary's River indicates degraded habitat quality.

*Off-Channel Habitat*

Only three small areas of off-channel habitat were observed on the Mary's River. The incised nature of the channel limits the formation of off-channel habitat.

*Refugia*

No significant aquatic refugia occur on the Mary's River within the UGB. Water withdrawals outside of the City, riparian degradation, and alteration of the historic floodplain and hydrograph have led to systemic changes in the aquatic habitat. Remnant areas of pristine habitat or refuges for sensitive aquatic species do not occur on the Mary's River within the UGB.

*Streambank Condition*

Approximately 570 meters of eroding stream bank was present in the 6,100 meters of surveyed reach of the Mary's River. The large amount of erosion is likely the result of historic human activities, as well local geology and the sinuous nature of the river. Most of the erosion occurs on the outside edge of channel meanders or is associated with LW accumulation and jams. Bank erosion appears to be just as common in areas with extensive riparian buffers as in those developed for agriculture or residential purposes. A variety of bank stabilization strategies such as planting, concrete retaining walls, and riprap revetment are employed in the lower portion of the reach.

*Floodplain Connectivity*

Floodplain connectivity of the Mary's River is low. The channel is incised 4 to 5 m, making over-bank flows uncommon. Potential riparian wetlands are perched; hyporheic nutrient and water exchanges have been severed or substantially altered.

*Change in Peak/Base Flows*

Water rights in the Mary's River (outside of the city) have been over-allocated. Instream withdrawal rights exceed flows during the months of September, October and November. Instream withdrawal rights plus allocated rights exceed flows from June through November. The over-allocation of water has been implicated as a likely cause of the decline in the Mary's River cutthroat trout population (Ecosystems Northwest 1999).

*Disturbance History*

The Mary's River watershed is highly disturbed. Private and public timberlands in the upper reaches of the watershed have been heavily logged in the last century. Very little late successional stage old-growth stands exist in the timberlands of this region of the coast range. Many stands are young second- or third-growth forests. The Willamette Valley portion of the watershed has also been heavily altered. Once covered in native wetland and upland prairies and gallery forests, the valley bottom portion of the watershed has been largely converted to agricultural lands.

*Riparian Reserves*

Riparian reserves have been significantly depleted along most of the Mary's River within the UGB. Agricultural fields, residential developments, roads, parks and a golf course are all located adjacent to the river. Riparian vegetation is often restricted to a narrow strip of streambank between the top of bank and the wetted channel. Invasive species have colonized much of the riparian area. Himalayan blackberry commonly grows on the stream banks and reed canary grass is the dominant species along the margins of the channel.

**Willamette River (From Corvallis Stormwater Master Plan, 2000)**

*Habitat Features*

The Willamette River forms the eastern edge of Corvallis' UGB. Project team biologists walked the western shoreline to identify important habitat features and problem spots.

The western shoreline can be divided into three distinct and approximately equal reaches: a side channel reach, a mainstem reach, and a mainstem reach with revetted banks (see map).

Near its southern end, the UGB is bordered by a series of side channels of the Willamette River. These side channels are deeply incised, and contain very little off-channel habitat. Narrow, low terraces are present on both banks. The low terraces increase in width near their confluence with the Willamette River. Substrate in the side channels was an even mix of fine sediments and gravel. Riffle habitat was uncommon. LW concentrations were low, probably the result of channel incision and width as well as lack of upstream recruitment. The channels are separated from agricultural fields by narrow strips of riparian vegetation. The widths of these riparian areas average approximately 50 feet and are often limited to the area below the top of bank. Riparian vegetation was composed of cottonwood, Oregon ash, and Douglas fir. Reed canary grass was the dominant species near the water's edge.

Between the south UGB boundary and the mouth of the Mary's River, the mainstem Willamette River is only partially incised. In Willamette Park, despite the revetted areas, much of the west bank slopes gently and has been contoured into several overflow channels. These overflow channels create alcoves of off-channel habitat. The substrate of the mainstem appears to be dominated by cobble and gravel substrates. Fine sediment and gravel are the dominant and subdominant substrates in the overflow channels. The riparian overstory is dominated by cottonwood and Oregon ash. Himalayan blackberry is the dominant understory shrub.

Downstream from the confluence with the Mary's River, the mainstem channel becomes confined between riprap lined banks. No off-channel habitat or refuge occurs in this reach. The riparian area is very narrow and is largely composed of willow and blackberry bushes. The instream habitat is composed of a single continuous run. The downtown area and Highway 20 closely parallel much of this reach and limits the potential for any rehabilitation activities.

The Willamette River receives all the agricultural and urban chemicals listed for the previous streams. It also receives treated effluent from the City's Wastewater Treatment Plant. These wastewater discharges are monitored by the City and form part of the baseline

*Temperature*

The Willamette River is currently listed on the DEQ's 303 (d) list for temperature during the summer months. The City of Corvallis currently conducts temperature monitoring in association with its facilities, which forms part of the baseline dataset.

*Sediment/Turbidity*

The river is currently considered to be properly functioning in this category.

*Chemical Contamination*

See Dixon Creek for a list of urban chemicals that may occur in this basin. The river also may have some agricultural chemicals, such as atrazine and related compounds. Nutrient levels are considered to be properly functioning. The Willamette River has a mercury advisory in this area and also is listed for fecal coliforms (e. coli).

*Physical Barriers*

There are no physical barriers to fish movement in the Willamette River in this area.

*Substrate*

NOAA Fisheries likely considers the Willamette River as "not properly functioning" in this category, due to the perception of increased fine sediment inputs upstream.

*Large Wood*

Habitat surveys have indicated that there is little large wood in the system, due to changes in the riparian forests, natural river geomorphology, and river maintenance activities.

*Pool Frequency and Pool Quality*

This is considered to be properly functioning in this section of the river, but there are areas at risk. The construction of revetments in the area has changed the way the river responds, but as these generally occur on one side only, they shift the stream activities to the other side.

*Off Channel Habitat*

This is considered to be properly functioning in this section of the river, as there exists off-channel habitat upstream on the east bank.

*Refugia*

Intact, well-buffered riparian areas exist in very few areas. Residential and commercial developments, city parks, and agricultural fields all encroach on Willamette River riparian areas. This disturbance to riparian habitat has facilitated the introduction of invasive species such as reed canary grass and Himalayan blackberry. Encroachments into the riparian areas and channel modification limit the amount of suitable habitat available to sensitive aquatic species.

*Width-to-depth Ratio*

The width-to-depth ratio is greater than 12 in most of the mid and upper reaches of the mainstem Willamette River. This resembles the historic condition, which was likely heavy braiding on a broad alluvial flood plain.

*Streambank Condition*

It would be difficult to classify this indicator as properly functioning, as there is riprap present in some areas. Portions of the stream still have streambanks more similar to the historic condition (see above).

*Floodplain Connectivity*

This feature is likely to be at risk or not properly functioning. Connectivity with the floodplain has been removed on the west side of the river to control flooding..

*Changes in Peak/Base Flow*

Some very small changes in peak and base flows probably occurred as a result of channelizing and increased impervious surface, but these are dwarfed by the changes resulting from upstream dam construction, and the high amount of flow in the river itself. These channelized stream segments have a reduced capacity to detain flows during peak runoff events, and have little water storage potential. The increase in impervious surface creates quicker, higher spikes in runoff after rainfall events. The hydrologic changes associated with development have likely produced little change in the channel morphology, despite the presence of revetments, given the geology of the area and the geomorphology of the river in the Corvallis area.

*Disturbance History*

The Willamette River in the study area is an urbanized system. Increased impervious surface, riparian forest clearing, development along the tributaries and the mainstem, and agriculture practices have disturbed the river. Very little mature forest exists in the area.

*Riparian Reserves*

Some riparian areas still exist, especially in the Willamette Park area, but riparian systems have been heavily altered.

**Jackson, Frazier, Village Green Creeks (From Corvallis Stormwater Master Plan, 2000)**

This watershed consists of the Jackson, Frazier, and Village Green Creeks that form a complex network of streams and wetlands to the north of the Corvallis city limits. Jackson and Frazier Creeks both originate in McDonald-Dunn State Forest. The headwaters of Jackson Creek are located near Dimple Peak while Frazier Creek originates further north near Lewisburg Saddle. The two creeks flow eastward through the state forest and into low-density residential developments prior to merging at Highway 99. East of Highway 99 their combined flow enters the Jackson-Frazier Wetlands, an important habitat area. The flow leaving the wetlands is split. Part of the flow heads northeast across farmland to connect with the Willamette River at Bowers Slough, downstream of Lower Kiger Island. The remaining flow runs south from the wetlands as Village Green Creek. Village Green Creek turns to the southeast, flows through largely residential neighborhoods, and eventually joins Sequoia Creek to the east of Conser Street.

The Jackson Creek portion of the watershed contains over 1,500 acres, of which forest land is currently the largest land use (approximately 700 acres). Over 400 acres is currently undeveloped. In the future, the forest land will still be present, but the undeveloped land may largely be replaced by low-density residential development. The Frazier Creek drainage area is larger, with over 2,200 acres within its drainage boundary. Like the Jackson Creek area, the largest land uses are forest (1,000 acres) and undeveloped land (approximately 600 acres). In the future, the undeveloped land may become part of almost 900 acres of new low-density residential development. Currently two-thirds of the 380 acres draining to Village Green Creek are residential. This mix of low-, medium-, and high-density residential will remain the same in the future according to the City's comprehensive plan. The area designated as open space will increase slightly, from 28% at present to 33% in the future.

Village Green Creek is typical of many urbanized streams. It is highly channelized and in many locations has little or no available shade. However, there are few structures encroaching on the stream bank unlike many other Corvallis streams. The open stream banks, such as at Village Green Park are potential sites for projects to enhance stream and riparian health. For instance, in many areas of this watershed the floodplain can be reconnected to the stream, thereby enhancing habitat as well as alleviating downstream flooding potential.

Other stream systems (Jackson and Frazier Creeks above the wetlands, Dry Creek, Ryan Creek, the Millrace) were not evaluated as they contained no potential for being utilized as salmonid habitat. The influence of these systems on overall stream water quality was evaluated in the pathways evaluation section of the report.

**Corvallis Area ESA Riparian Area Mapping Summary**

All comments apply only to the area within the 400-foot-wide riparian corridor evaluation area.

**Dixon Creek**

- The mainstem (south of Walnut Avenue) is almost completely residential.
- The majority of the mainstem, although residential, includes a narrow strip of deciduous forest canopy that shades the channel.
- Street crossings that dissect the riparian zone are common on the mainstem.
- Tributaries (north of Walnut Avenue) generally are either in strips of deciduous forest bordered by unmaintained herbaceous vegetation or in continuous deciduous forest.
- Street crossings north of Walnut Avenue are uncommon or non-existent.
- Some first-order tributaries are in herbaceous vegetation.

**Oak Creek**

- Nearly all of the stream is bordered by a narrow strip of forest canopy.
- The lower 0.9 km (downstream from 35$^{th}$ Street) includes commercial/industrial and residential development; road crossings are common.
- Upstream from 35$^{th}$ Street, the forested area varies from very narrow to the full width of the riparian area, averaging 1/3 to 1/2 of the corridor width.
- Agricultural lands make up most of the remainder of the corridor above 35$^{th}$ Street.

- Above 35th Street, road crossings occur every 0.4 to 0.8 km.

**Mary's River**

- The riparian buffer along the Mary's River consists mostly of contiguous deciduous forest that extends the full 200 feet on each side of the stream.

- The forest strip is contiguous on both sides of the stream, for the full length of the stream within the UGB.

- A small amount of agricultural lands are located on the outer edges of the corridor just downstream from the point where the Mary's River enters the UGB.

**Dunawi Creek**

- Six major or complex road crossings fragment the system.

- Scattered but generally small pockets of commercial/industrial and residential development impinge on the corridor in several places.

- A forested strip is adjacent to nearly all of the stream, both mainstem, north fork and south fork; it averages about 1/3 the total width of the corridor.

- South of Philomath Boulevard, the remainder includes residential, commercial/industrial, and infrastructure developments

- North of Philomath Avenue, the remainder mostly consists of agricultural lands.

**Sequoia Creek**

- Riparian conditions vary along the length of the stream.

- More natural (shrubby) toward the downstream end of Sequoia Creek

- Large number of debris dams in the creek downstream of Jack London Street obstruct flows.

## BASELINE CONDITIONS – SUMMARY OF RESULTS

The available data from the streams in the Corvallis area, including the Willamette River, show that all have suffered considerable degradation from likely conditions prior to human settlement. They comprise typical urban streams with incised and straightened channels and riparian buffers reduced in size, continuity, and complexity. Off-channel habitat in the Willamette River has become considerably reduced, or disappeared altogether. While this plays a lesser role in the establishment of the baseline condition, the distinction becomes more important when a trajectory for recovery is considered.

The streams in the Corvallis area, with the exception of the Willamette River, likely contain no listed chinook salmon, except as occasional visitors to the systems during some portion of the winter high flow period. A cursory review of those characteristics required for successful spawning and rearing demonstrate why.

Chinook salmon selectively spawn in the tributaries to major rivers, in third- to fifth-order streams. In order for any of the Corvallis streams to be considered this complex, it would be necessary to include the uppermost tributaries of Dixon and Oak Creek, which have low or no year-round flow, and are unsuitable for spawning or rearing. Chinook spawn in streams classified as Rosgen-type C-3. This describes a stream with moderate sinuosity, a gradient less than 2%, and a high width-to-depth ratio, with numerous gravel pool-riffle complexes and side channels. No Corvallis stream resembles this description except in gradient. They more closely resemble Rosgen-type G-6 streams; low to no sinuosity and low width-to-depth ratio, and containing mainly silt-clay substrates.

Chinook salmon require gravel to cobble substrates in riffle areas for spawning (approximately 16 $m^2$ area per redd or spawning site), with high amounts of groundwater flow to irrigate the eggs, and low (less than 25%) amount of fine substrate materials that tend to clog intra-gravel spaces (Healey 1991). Preferred spawning areas consist of the transitional areas between pools and riffles found at the nickpoints between bounded and unbounded valley segments (Bjornn and Reiser 1991). This provides downwelling of streamflow into the gravels and upwelling of groundwater. The upwelling appears the most critical of the hyporheic functions for chinook spawning at the reach-level scale of habitat characteristics. Surveys in the Corvallis streams found none of this habitat present.

Throughout their range Chinook salmon spawn at different water depths. Water velocities vary as well. The lack of gravel, high degree of incision, and low flow rates in Corvallis streams make them unsuitable for chinook salmon spawning. While adult Chinook salmon can venture up Corvallis streams, and indeed one was caught in Dixon Creek in the 1950s, spawning adults actively select habitat, and show a preference for the above-mentioned habitat features. Clearly, no successful spawning could occur in these streams, as they contain no habitat.

After hatching, spring chinook salmon spend a more extended portion of their life cycle in fresh water, unlike fall chinook, which migrate to the estuaries after a few weeks. Rearing areas consist generally of side channel areas with deep pool-riffle complexes with an abundance of overhead cover, cool temperatures, and drifting stream insects. These pool-riffle complexes play an important role in salmonid growth and survival (Healey 1991). As salmon are visual predators, water clarity is highly important.

None of the surveyed streams contain any of these elements. Flows are often intermittent, even in the mainstem of some of the streams (e.g. Dunawi Creek), temperatures are high, when flows are high the water is quite turbid, pool-riffle complexes are generally absent, and existing pools are quite shallow. Existing gravels were quite embedded (filled in by sand or silt). This armoring makes them quite difficult to use effectively, whether by juvenile salmon as cover, or as habitat for macroinvertebrate prey species. The lack of these necessary elements of chinook rearing habitat makes Corvallis streams unsuitable for this life history stage, as any rearing habitat in Corvallis streams would be of extremely low quality. Habitat existing in this area would likely only comprise of winter refuge habitat, occupied when flows in the Willamette River become too strong.

When juvenile chinook salmon move from one habitat to another upon hatching, this movement initially goes downstream, not up, essentially a drift. The fact that juvenile chinook salmon barely swim fast enough to stay ahead of the river current strongly suggests that they can spend little time or effort searching out tributary habitat upstream of where they end up, and indeed, likely often find themselves transported by flood flows into areas not suitable for rearing (Healey 1991). Juveniles generally don't drift for long before finding suitable habitat within their natal stream. Juvenile salmon will move as much as 6 km from their natal stream in search of suitable cold, clear pool-riffle complexes to overwinter and rear (Murray and Rosenau 1989). Therefore, juvenile chinook salmon from the Mollala and Santiam Rivers are not likely to seek habitat upstream in the Willamette River, particularly as this necessitates swimming against the current. Following establishment of residence, movements become relatively restricted (Richards and Cernera 1989).

The vast majority of fish moving downstream from the tributaries of the McKenzie and Coast Fork-Willamette likely find sufficient suitable habitat associated with those streams. Studies done as part of the McKenzie Confluence Study and the McKenzie Subbasin Assessment confirm this. Very few fish were found in the Willamette River and the lower McKenzie River during the studies, despite the presence of "above-average" habitat in this area.

There exists no historical record of spawning or productive rearing in any of the streams in and around Corvallis, excepting the Willamette River. It is likely, given their size, hydrology, and geomorphology, that they have never been "chinook" streams. Therefore, impacts to spawning and rearing areas are not critical elements in determining the potential for take resulting from actions by the City.

Despite this, Corvallis streams play a role in the baseline water quality of the Willamette River, and may provide high-water refuge habitat to a small percentage of the total population. As a result, barriers at the mouths of some of the streams could impede use of these areas as refuge habitat. However, during the winter months, flows in Corvallis streams, though quite flashy, may ensure no barriers to access to the lower ends of Oak and Dixon Creeks, the two urban streams likely to serve as refuges.

Riparian areas also play a critical role as shade sources to decrease temperatures, as filters for removing contaminants, and in preventing instream and bank erosion. Especially in the lower reaches of the streams, riparian areas have been severely diminished through development activities.

Channelization results from increased development in the floodplain of the stream, and causes degradation of instream habitat through erosion and simplification, or lack of structures and elements that are necessary to create habitat. The use of streams as stormwater conduits in urban areas further contributes to incision, and diminishes and eventually removes altogether the floodplain connectivity of the system.

Therefore, despite the lack of any focused use of the systems by Chinook salmon, the impacts from contaminants, impervious surface, riparian buffers, and instream habitat conditions (erosion and excessive sedimentation) all play a critical role in the determination of water quality. The result of all this activity, along with the basic human activities associated with living, be they urban, suburban or rural, leads to diminished water quality in these streams. Eventually, this makes its way to the Willamette River, where it may result in a "take."

The Willamette River differs from the other streams, however, as both immigrating adults and emigrating juveniles use the area fronting Corvallis. Adults move upstream from April through June and juveniles move downstream from February through May. Some additional movement occurs in October and November. Conditions in the mainstem Willamette in this area appear mainly unsuitable for any extended rearing or successful spawning, despite the presence of fish in these areas, and so these habitat types are not affected by City activities. It may be that some use the off-channel habitat on the east side of the river, and the presence of structures on the west side as resting areas. This makes activities both in and ultimately affecting the Willamette more critical in terms of take of listed species.

# CHAPTER 6. PATHWAYS/EFFECTS ANALYSIS

## INTRODUTION

This chapter describes the combined baseline conditions and pathways/effects data for identifying the geographic distribution and the degree of impact that City services and citizen behavior have on Chinook salmon habitat. It discusses these activities and their effects in terms of their spatial (geographic distribution), temporal (time) and intensity (concentration) scales.

The chapter relies on three sources to identify impacts. First, it relies on an approved methodology for evaluating city activities and their impact on chinook salmon habitat in the project area (see Appendix 4 for a copy of the Technical Memorandum, *Methodology for Pathway Evaluation*). Second, it draws on a weighted database that has been created to analyze city activities and their impacts on Chinook salmon habitat and water quality. The weighted database contains approximately 4,300 records that cover the range of city activities that can impact habitat (see Appendix 5 for a CD with the entire database). Finally, it relies on information and baseline conditions work from Phase I of the ESA study (see *Baseline Habitat Evaluation and Evaluation of the City Activities*, February 2002, in Appendix 6 and NOAA Fisheries letter response in Appendix 7).

The methodology for this analysis compares and ranks activities as to their relative impact on Chinook salmon habitat and water quality. This approach provides a mechanism for evaluating the effects of City activities and events and citizen behavior at any geographic level desired by the City (e.g., reach, stormwater basin, citywide, and UGB). It allows for a comparative ranking of the effects to identify different degrees of impact, and it provides a framework for fiscal analysis. This analytic framework can help the City allocate its limited financial resources for habitat rehabilitation and recovery, and water quality improvements.

Given the number of records and the many ways of organizing and analyzing the data, this discussion confines itself to broader spatial and time scales rather than to specific impacts. It summarizes the results of the analysis and identifies some of the major impacts to Chinook salmon habitat identified in the database and the Phase I analysis. Using this approach it is possible to draw a number of more generalized conclusions about City activities and their impact on Chinook salmon habitat.

## WEIGHTED DATABASE KEY ELEMENT DESCRIPTION

### Database Set Up

The database is set up to evaluate impacts that City activities and citizen behavior have on Chinook salmon habitat and water quality. The structure of the database and the weightings is based on actual, not hypothetical, use of the streams by Chinook salmon. Since Chinook salmon use of Corvallis streams is very limited, it bears repeating that the findings of Phase I of this project provide the setting for the database structure and impact analysis.

The baseline analysis in Phase I indicates that streams in Corvallis do not now, or in the past, contain the elements Chinook salmon require for spawning and rearing (see Appendix 6 for the *Baseline Habitat Evaluation and Evaluation of the Impacts of the City Activities* February 2002, and Appendix 8 for the *Technical Memorandum on Chinook Salmon Habitat in the Upper Willamette River ESU* 3/3/03). Chinook salmon potentially gain access to and may use the lower reaches of some of the streams for refuge during high water flows in the Willamette River. Juvenile Chinook use the Willamette River for rearing and movement. Adult Upper Willamette River Spring Chinook salmon use the river as a migration corridor. Neither juveniles nor adults use the upper reaches of Corvallis streams.

Therefore, while Chinook salmon may gain temporary access to Corvallis streams, the streams provide none of the elements necessary for spawning and rearing. Consequently, the results of the weightings analysis focus mainly on impacts to water quality, which can realistically influence Chinook salmon habitat downstream, outside of the project area.

The analysis in this report focuses on the predetermined stormwater basins the City uses for its stormwater management program. By doing so the City can link activities and their weighted impacts in this study to other important City programs, such as control of stormwater runoff impacts to water quality. The advantage of piggybacking onto the stormwater basins and the reaches within them makes it possible to define areas where natural processes act in a similar fashion and City activities have similar impacts. Such organization also allows for the identification of "fixes" that can, where possible, be integrated with other ongoing City activities to improve watershed health.

Another advantage of the weighted database analysis is the incorporation of land use/zoning designations by reach. Land use can significantly impact Chinook salmon habitat. Fortunately, zoning characteristics determined to have negative impacts on habitat may be modified or changed to incorporate land use or development activities, mitigations, or even best management practices (BMPs) to help preserve or restore riparian function and water quality in the Willamette River and its Corvallis tributaries.

**Pathway Scoring and Weight Score Assignment**

Weight scores are based on five factors. They are the four pathways as defined by NOAA Fisheries and a fifth factor that accounts for proximity of a City activity to a city stream. Citizen behavior can also impact Chinook salmon habitat and water quality, but it is evaluated as a separate category. The database evaluates each activity or event for the above pathways, contaminants, impervious surface, buffers and barriers, and weights City activities according to its location inside or outside a 200-foot stream corridor.

The following sub-sections describe the pathways and score values assigned to each pathway. Values vary depending on the pathway. Some pathways exhibit little or no variation while others have significant variation.

*Contaminant Pathway*

Weighting factors for the contaminant pathway do not vary by stream location. Contaminants are considered to have relatively the same impact on water quality regardless of the location at which the contaminant enters the stream. Contaminants in the water produce direct effects, through toxicity to one or more life stages of the fish or other elements of the food web, or indirect sub-lethal effects on growth and vitality.

The difficulty comes in separating these sub-lethal effects from normal Chinook salmon population variation, as well as normal variation that occurs within and between seasons. NOAA Fisheries regards sub-lethal effects as highly important to the long-term survivability of the Chinook salmon population, as they diminish lifetime reproductive output, usually through effects on growth, reproduction, sensory or motor functions, or food supply. Though Chinook salmon rarely inhabit Corvallis streams (except the Willamette River), if at all, and only during peak flow times, the impacts resulting from City actions are considered indirect and citywide in their spatial distribution. Because of the above-mentioned difficulty in separating sub-lethal effects from normal variation, sub-lethal effects are included in the overall contaminant score.

*Impervious Surface Pathway*

The impervious surface pathway weighting values vary widely because of the variability of existing impervious surface in Corvallis. The lower reaches of Corvallis streams, those closest to their confluence, where there already exists a high percentage of impervious surface are assigned lower negative weight values for City activities than upstream reaches, where there is a much lower percentage of impervious surface. This is due to the fact that additional impervious surface in a lower reach would not impact Chinook salmon habitat as much as in a reach with little or no impervious surface (i.e., areas with little development).

*Buffer Pathway*

The weightings for the buffer pathway follow a similar rationale as that for the impervious surface pathway. Reaches where buffers are already narrow tend to have lower weightings than reaches with existing wide buffers.

The importance of the buffer or stream corridor characteristics pathway varies. Changes in the riparian condition (e.g., shade, LWD, impervious surface, bank stability, etc.) can result in an increase in instream erosion and an eventual loss of habitat structure and diversity. The increased hortonian (overland) water flow that can happen with a reduced buffer can contribute more sediment and contaminants to streams. Other riparian conditions such as infiltration can be impacted with diminishing buffer size.

The presence of LWD diminishes with lowered riparian connectivity. A buffer zone with no large trees contributes no LWD to the stream channel. Buffer values generally increase with decreasing stream gradient, as do vegetation mosaics.

In the case of Corvallis, the most important buffer functions are to maintain water quality. Buffer community structure has less importance. Recent information suggests that the historic riparian buffers in the lower reaches of Dixon, Dunawi, Oak, and Sequoia Creeks consisted of prairies, with the upper, higher elevation areas containing the more dense oak and conifer forests. Width typically increases in a downstream direction, as floodplain size increases. Research suggests that the riparian buffer width in these areas has actually increased over what existed historically, at least in terms of trees and shrubs (S. Gregory, personal communication [pers. comm.] 2003).

The lower reaches of Dixon, Oak, and Sequoia Creeks contain the highest negative riparian buffer scores, as they contain the highest concentration of urban development and activities. The large concentration of urban activities has converted the natural buffer to impervious surface, which has narrowed the natural buffer corridor width.

Urban development and road crossings also cut the continuity of the riparian buffers, negatively influencing their function, and potentially restricting free movement of water along the corridor and decreasing vegetation diversity. Dunawi and Dixon Creeks provide good examples of the importance of continuity. Both creeks have similar types of development activities occurring in the upland areas. Despite this, on Dixon Creek Reaches 1, 2, and 3 the riparian buffer consists of a single row of trees for most of its length, as opposed to the more extensive riparian buffer on Dunawi Creek. The change from prairie and gallery forests to treed areas increases the shading of the area, but decreases the mosaic or buffer community structure, simplifying its composition and changing it from native to predominantly non-native species.

The presence of urban development within the stream corridor and buffer area generally decrease shade in the riparian zone, which can result in higher stream temperatures. Buffer areas with shrubs or young trees provide little shade, grasses even less, with lawns providing none. While the thin riparian buffers may provide some shade, all reaches suffer from high temperatures by August. These temperatures likely resemble historic trends as the increased riparian tree cover in the lower reaches of creeks like Oak and Dixon, which are not believed to have existed prior to urban development, balances the loss of historic, low temperature groundwater inputs.

This potential for temperature increase is less important in upper stream reaches as higher gradients move water more rapidly through the system decreasing residence time and exposure to the sun. In the lowland reaches, water remains in the stream longer, and may reach temperatures too high for salmonids.

While almost any bank vegetation provides a buffer and protection against erosion, the quality of this protection can vary. In the incised lowland reaches of the streams, the presence of trees in the riparian corridor provides little bank protection, despite their extensive root systems. Grasses play an even smaller role for bank protection, although both do provide some protection against erosion from overland flows. The critical reaches to protect remain those highest up in the systems, as these have not yet incised to the degree of the lower ones. Reducing the intensity and magnitude of flows resulting from stormwater inputs in the higher reaches of the system will serve to slow the process of incision in the lower reaches. Historical analysis, and the nature of the Corvallis area soils and topography, all suggest the inevitability of incision by most streams. Despite this, the lack of incision on Dunawi Creek has produced a viable riparian corridor and buffer width in the non-urbanized reaches, with some streamside wetlands remaining in the upper areas.

*Barrier Pathway*

Barriers can prevent fish passage and access as well as block the development and/or maintenance of salmonid habitat. Natural processes and human activities can both create barriers. Debris jams, waterfalls and seasonal downwelling (a stream that goes underground) are examples of natural barriers. Dams and culverts are examples of barriers created by human activity. Depending on the barrier, fish passage access may be restricted seasonally or permanently. The concern for the City of Corvallis is the degree to which human-made barriers in the streams negatively impact Chinook salmon passage and habitat.

The evaluation and scoring of barriers depends on their location and the degree to which they prevent passage or access. The barrier pathway is scored by the following process. Barriers that are located in lower reaches or at a stream's confluence are considered to have a greater negative impact because they prevent access or passage to a larger part of the stream's habitat than those in higher reaches. Therefore, lower stream barriers are assigned a higher number. Secondly, barriers that permanently prevent passage and access are considered to have a greater negative impact and are scored higher than seasonal barriers (e.g., barriers to passage and access during low flow). This is important where Chinook salmon have been known to seek off-channel refuge in Dixon Creek during high water flow in the Willamette River.

*Stream Corridor Distance Factor*

A fifth factor is included in the weight scores to account for differential impacts of City activities and events and citizen behavior on Chinook salmon habitat related to distance from a stream. Activities and behaviors occurring within the study area (200-foot corridor extending upland from the top of the bank on each side of the stream) as opposed to the same activities and behaviors occurring outside the corridor are considered to have a higher potential habitat impact.

There are three reasons for this difference. First, activities and behaviors occurring within the stream corridor influence listed fish and their habitat directly without the need of a transport mechanism or pathway to convey the impact to the stream. Activities and behaviors occurring outside the corridor often require intervention of a transport mechanism or pathway such as the stormwater system to convey the impact to the stream.

Second, activities and behaviors within the stream corridor can directly affect riparian buffer characteristics, which are critical to maintaining the health of Chinook salmon habitat. The further the activity or behavior is from the stream, the less likely it can impact the riparian buffer characteristics.

Third, NOAA Fisheries recognizes that there is a spatial relationship between urban oriented activities and impact to salmonid habitat. NOAA Fisheries cited in their preamble to the proposed 4(d) Rule a 200-foot corridor or buffer from streamside within which urban activities could potentially have a greater impact on salmonid habitat. NOAA Fisheries has gone on to state that the most "effective way to ensure PFC [Properly Functioning Condition] is to manage MRCI [Municipal, Residential, Commercial, Industrial] development activities in riparian areas so that their impacts on habitat functions are minimal at the streamside, but may gradually increase with distance from the stream." (Federal Register/Vol. 65, No. 132, pg. 42462).

The City used the 200-foot corridor width proposed by NOAA Fisheries as the riparian study area boundary, simply to provide consistency with the guidance. The presence of this area precludes no activities, but simply defines an area that NOAA Fisheries will scrutinize heavily in their analysis of any plan seeking ESA 4(d) Rule compliance. Consequently, weight scores are adjusted to increase the impact that an activity or behavior can have if it is located within the corridor. The weighting factor within the corridor increases the numerical score by a multiple of three.

### Urban Activities and Impacts

The four pathways and the location factor are important in determining an activity's impact on water quality, but they do not describe the activity itself. They are external factors acting as a pathway to or a location relative to the stream. When considering the activity itself three additional factors are used to determine an activity's impact and the degree of impact it has relative to another activity. The three factors are magnitude, periodicity and intensity.

#### *Magnitude*

Magnitude refers to size or spatial extent of an urban activity. Size plays an important role in the level of impact on water quality; the larger the area the activity covers, the greater potential for impact. For example, discharge from a single stormwater outfall located in an upper reach of a Corvallis stream would not have the same impact on Chinook salmon habitat and water quality as the combined impact from all stormwater discharges.

Magnitude of an activity is rated or scored according to the area of its spatial distribution. The smaller its distribution, the smaller its impact on Corvallis streams and therefore the smaller the score. The smallest magnitude is an activity with a single or point location. This is scored a One. Activities with the biggest spatial distribution are considered to have an impact basin-wide and are scored a Four.

Among City activities that may have the greatest impact on Chinook salmon habitat due to magnitude are those related to land use and development. The wide spatial distribution associated with different types of development and the requirements set forth in the land development code (LDC) affects large areas of the City.

For example, the urbanizing upland areas in Oak Creek, Dunawi Creek South Fork, and Dixon Creek Middle and West Fork are beginning to display similar impacts as their lowland reaches – incising due to increasing water volume and velocity, removal of buffer vegetation, and sediment transfer. Widespread residential development has added and is adding significantly to the amount of impervious surface in these upper reaches. The magnitude of this development has a significant impact on the potential Chinook salmon habitat and water quality. Activities in this area receive higher negative scores due to the presence of increased residential development and associated increases in impervious surface. The higher slope of the areas in question also exacerbates the negative contributions to flow from impervious surface and stormwater runoff. Further removal of the buffer in these areas increases the potential for erosion.

The magnitude of impervious surface from urban development and subsequent stream channel alteration in the lower reaches has significantly influenced water quality. The lower reaches of all streams contain high levels of impervious surface and associated runoff. The percentage of impervious surface in the lower reaches of both Dixon and Oak Creeks exceeds 70 percent.

*Periodicity*

The frequency and duration of an event or activity can exert considerable influence upon the ability of the stream system to rebound from disturbance and remain in properly functioning condition for Chinook salmon habitat. Historic habitat-forming processes typically consisted of single-event or episodic occurrences. For instance, a tree falling into a creek is a single event, while flooding (e.g., 2-year 10-year, 100-year, etc.) and seasonal flows are considered episodic events. The periodicity of their occurrence allows the stream time to react and rebound.

Activities are rated according to their periodicity using a One to Four scale. Single event activities are those with the shortest period and are rated One. At the other end of the spectrum are chronic events or events that have a continual impact on the stream system. Chronic events are rated a Four. In between are episodic (occur with no predictability) and periodic events (occur at predictable intervals, separated in time) that reflect increasing impact to water quality. They are rated Two and Three respectively.

Many City activities and citizen actions, however, are not single or periodic events. They fall into the chronic category of events that occur on a continual basis, such as regularly scheduled City maintenance activities for transportation, utilities, and parks. The chronic nature of these activities may actually apply more stress on the ability of the system to react and rebound. Instead of the system reacting to single or episodic events, the watershed is constantly receiving inputs. The reaction to chronic inputs can have a very different impact on a watershed than single, episodic or even periodic events.

*Intensity*

Intensity refers to the strength or concentration of the activity's or event's contribution to the impact. The higher the intensity or contribution that the activity or event has on the water quality, the greater the intensity score. For example chemicals in herbicides, pesticides or fertilizers can vary in concentration. If they enter the stream their impact will depend on their strength (in this case toxicity to Chinook salmon) and concentration. Stormwater discharge can also vary in intensity. A stormwater outfall along a creek could have a low, medium, or high intensity impact depending on the volume of water and the contents in the runoff.

A rating of One to Three is used to score the intensity factor. Events or activities that are considered to be of low intensity would be scored a One, while events or activities of high intensity would be scored a Three. An event or activity of medium intensity would be scored a Two.

*Ratings*

Three ratings were applied to City activities and events, depending on their magnitude, timing, and intensity. A few examples should illustrate how the rating process was conducted.

One example that demonstrates the rating process is park maintenance and herbicide use. The City has a small program that uses primarily backpack sprayers but also uses aerosols and granular products. Non-selective post emergent and non-selective pre-emergent herbicides are used periodically on developed landscape areas or on invasive plants, such as blackberries, along stream corridors. Application techniques and practices vary by site. Insecticides are predominantly used in treatment of structural and nuisance insects (e.g., sugar ants). While the Parks and Recreation Department goes to great lengths to minimize the environmental impact when maintaining their parks, they do still have a potential impact on Chinook salmon habitat and water quality. The following is the analysis used to rate maintenance activities and herbicide use.

- Magnitude: There are a number of parks located adjacent to Corvallis streams. While they are at specific or discrete locations along creeks, they are not a point location, but more likely cover several reaches. Therefore, the Magnitude is a reach (rate 3).

- Timing: Maintenance is conducted year-round, though different types of pesticides are used at different times of the year. Therefore the timing is chronic (rate 4).

- Intensity: Herbicides contain chemicals that may harm water quality and impact stream habitat. Therefore there is a potential for herbicides, should they enter the stream, to have a negative impact. Since herbicides are not used extensively and application techniques are adapted to site conditions, the intensity of the impact may vary, but generally it is considered low (rate 1).

A second example is stormwater runoff. In the LDC there are street standards that outline how development must handle stormwater runoff. Section 4.0.70 of the LDC defines minimum street standards for development. Stormwater drainage is required on temporary dead-ends. Alleys are required "in commercial and industrial districts to serve abutting properties unless other permanent provisions are approved by the Planning Commission or Director." New development and roadways increase impervious surface. The stormwater collection requirements, while important for keeping water off the roadway and other property, can increase the rate of runoff, concentrate pollutants, and interfere with groundwater recharge. If development is outside of the downtown area that is currently served by the City's combined stormwater and wastewater collection and treatment system, stormwater will likely end up being discharged directly to streams, which can have a negative impact on Chinook salmon habitat/water quality.

- Magnitude: The requirements apply throughout the City; therefore the magnitude is basin-wide (rate 4).

- Timing: The impervious surfaces will continue to exist for a long period. The timing is considered chronic (rate 4).

- Intensity: the intensity could be low or high depending on the location of the development and whether it is within the City's combined stormwater and wastewater collection and treatment system. If it is within the City's combined collection system the intensity is low (rating 1). If it is outside the collection system, it could be medium or high (rate 2 or 3).

## SUMMARY OF IMPACTS – CITY ACTIVITY AND CITIZEN BEHAVIOR

The following summarizes the assessment of City activities and citizen behavior on Chinook salmon habitat and water quality in Corvallis streams. The assessment methodology is described in detail in Chapter 5 and the pathway data from which this summary is taken is provided on a Compact Disk (CD) in Appendix 5 and in the Phase I report (*Baseline Habitat Evaluation and the Evaluation of Impacts of City Activities, February 2002,* Appendix 6).

Since there are 4,375 records in the database it is not possible to provide specific details for all activities. This summary highlights the range and degree of impacts that City activities and citizen behavior have on Chinook salmon habitat and water quality and their geographic distribution. The activities examined include construction, operation, and maintenance of public infrastructure (e.g., utilities and transportation); parks and recreational facilities; land development; planning and policy development to provide infrastructure, transportation and park facilities; and citizen behavior.

Not all City activities negatively influence habitat and water quality. The City has made progress, through its LDC, toward requiring development to minimize the impact on surrounding natural resources. The City is also making progress toward preserving significant natural features identified by its Statewide Goal 5 work. Similarly, park facilities design for trails and pathways must minimize their impact on sensitive areas. This section focuses primarily on City activities that have negative outcomes, as these are the ones the City is developing proactive measures to avoid, minimize or improve in the future.

**Stormwater**

The stormwater collection and conveyance system has, perhaps, some of the greatest impacts on streams. Chief among these is the impact upon the streams by changing the hydrograph. The number of outfalls in the system and the relatively little on-site detention means that the greatest amount of stormwater acts as channelized flow into the streams, rather than percolating and entering the stream gradually through the groundwater system. Stormwater also serves as the conveyance or pathway for a number of other activities that can negatively impact habitat and water quality.

In Corvallis streams, some of the greatest negative impacts result from both increased erosion (in the upper reaches) and increased sedimentation rates in the lower. . Other pathway impacts include temperature changes, either through the warming of pooled water in detention facilities, or when stream flows are low during the dry season.

Other negative impacts from the stormwater system include the presence of barriers to fish movement caused by culverts (also a transportation impact) and the use of fertilizers, herbicides, and pesticides for vegetation control and maintenance along watercourses and in streams. Other contaminants, as well as sediments, get introduced into the system through the flushing process. Ditch maintenance also contributes to runoff and the introduction of contaminants.

The City has made progress in the reduction of some of these negative impacts. In the urban core, the City collects and treats most stormwater runoff. Stormwater is conveyed to the City's wastewater treatment facility where it is treated and discharged to the Willamette River. Outside of the urban core, stormwater continues to have a negative impact on the habitat and water quality in City streams.

**Wastewater**

Wastewater impacts include the introduction of contaminants and alteration of temperature. There are scenarios that could involve spills of wastewater and discharges that could introduce raw pollutants or treatment chemicals directly into the system (spills, overflows, leaking pipes, and pumping system failures). Effects of these discharges can have both direct toxic and sub-lethal effects on the fish themselves, though habitat impacts in these cases are likely to be negligible.  New construction, such as the pipelines the City is planning along stream systems would have impacts related to the construction (increased erosion and sedimentation) and removal of riparian vegetation (the buffer) leading to increased temperatures from shading loss or increased sedimentation from bank erosion.

**Drinking Water**

The potable water system impacts occur as the result of raw water withdrawal from the Willamette River (instream habitat pathway) and its return to the system through the wastewater and stormwater systems, causing flow alterations and hydrograph changes. The introduction of contaminants through the effluent from backwashing of water filters, and flushing of pipes may prove critical, as does scheduling of any maintenance activities, as actions done during low water conditions do not benefit from dilution effects.

**Transportation**

Impacts from the transportation activities (e.g., improvements, new construction, the existing transportation network, and operation and maintenance) can have a significant negative impact on Chinook salmon habitat/water quality.  Impacts may come from transportation improvements (e.g. the road design), their location in relation to city streams, increased traffic, increased maintenance and operation requirements, and from the construction activities themselves.  Construction within the 200-foot study corridor has immediate impacts from increased erosion and sediment transfer to streams, increased impervious surface and resultant stormwater runoff-related changes to the hydrograph, and inputs of contaminants from the road surface.  There can also be impacts to the riparian vegetation buffer continuity, composition, and width.

Construction outside the stream corridor may also have negative stream impacts resulting from the impervious surface and contaminant conveyance.  Increasing stormwater runoff into the conveyance system will negatively impact instream habitat by altering the stream's hydrograph and introducing contaminants from the roadway surface (primarily petroleum based oils and grease).  Greater impervious surface from roadway construction or widening will also reduce infiltration and increase runoff volumes and velocities.  Similar impacts to the water quality result from the existing roadway network.

Operation and maintenance associated with de-icing roads, though rare in winter, introduces contaminants either directly into the stream system or into the stormwater system, with the same eventual destination.  Roadside mowing decreases the ability of the vegetation to slow overland flow, by decreasing the surface roughness and to allow the stormwater to percolate.  Bridge washing, maintenance, repairs, and painting can result in toxic or sub-lethal effects on fish or their food organisms.

Culvert cleaning and repair may introduce sediments into the stormwater or stream systems, causing an increase in total suspended solids.  Overall operations and maintenance activities can have negative water quality impacts to Chinook habitat, though these activities are likely to be sub-lethal in nature.

**Parks and Recreation**

An examination of parks planning, design, construction and maintenance indicates two major pathways for impacts upon fish habitat – impervious surfaces and contaminants. Existing parks have an impact on habitat through design and maintenance. Design elements include trails, parking lots, park structures, landscaped areas, and playing fields. All of these can modify the existing conditions by increasing impervious surface and surface water runoff, with effects like those outlined for stormwater and wastewater. This can be a significant problem since the City has a number of park facilities adjacent to streams and rivers.

Since parks do not have stormwater collection, treatment and discharge facilities to handle runoff, the impervious surfaces, which can include turf fields, tend to produce hortonian flow into the streams. While sod areas may allow some stormwater infiltration, asphalt and heavily compacted soil, gravel and grassy surfaces still increase hortonian flow into the streams.

While the City Parks and Recreation Department has had some success in reducing the use of pesticides and fertilizers, effective substitutes have been difficult to find. The application of these chemicals can result in soil contamination, and eventually stream contamination through stormwater runoff. Maintenance actions utilizing these chemicals along the streams can have a direct negative effect, despite localized dispersal methods. Indirect effects occur as the result of sheet flow runoff from parts of the park system outside the stream corridor.

New parks may impact Chinook salmon and water quality through the same two pathways – impervious surfaces and contaminants. New construction also may commit a direct take on critical habitat (if NOAA Fisheries lists these streams as critical habitat) through placement in the riparian zones of the streams or by usurping other hydrologic features (e.g. wetlands).

**Land Use**

The greatest impacts on Chinook salmon/water quality occur with land development. Development (both private and public) often increases impervious surface. The degree of impact depends upon location, type and size of the development, construction methods and materials, and level of stormwater treatment.

Locations with potentially greater negative impacts include those adjacent to stream courses and in riparian buffer areas – essentially within the 200-foot stream corridor. Development resulting in stream crossings and structural encroachments can break riparian and buffer continuity and can also have negative impacts on streams. When this happens, species composition usually changes, sometimes quite radically. Similarly, removing trees and replacing native oak gallery forest with maintained lawns and non-native vegetation decrease a great many of the functions of a riparian system, especially those associated with water quality (temperature and filtering). Even a lawn, if compacted sufficiently, can act as an impervious surface, and the length of the grass may be too short to be effective as a filter strip, or as shade.

Development often causes the separation of streams from their floodplains, through methods to reduce property damage by flooding. As a result, runoff volume and velocity will increase, which can result in incising, sedimentation, and stream contamination. Streams are also constrained by infrastructure development such as streets and culverts. These barriers may increase the negative impact to Chinook salmon/water quality by restricting access, although this likely doesn't occur in Corvallis.

Impacts to Chinook habitat and water quality vary among different land uses, such as residential, industrial, commercial. Residential low-density housing can impact Chinook habitat through yard-maintenance activities, whereas higher residential density may have greater impervious surface runoff. Industrial land use whether heavy or light can impact Chinook salmon habitat. There may be greater potential for chemical contamination from these activities. The degree of impact from commercial land use depends in part on the size of the development and mitigation steps taken (either required or voluntary) to avoid, minimize or reduce these impacts.

*Land Use Planning and Development Code*

The Comprehensive Plan for the City of Corvallis serves to organize city development activities. It contains a vision of the future for its jurisdiction. Among the plan elements are goals and policies that guide future land development, development intensity and spatial distribution of activities, and the preservation and protection of resources such as waterways, riparian zones, forest, and significant wetlands.

The LDC helps to implement the Comprehensive Plan. At this time the LDC does not sufficiently addresses protection and preservation of habitat, riparian corridors, open spaces, and significant natural features that the Comprehensive Plan addresses. The Comprehensive Plan and LDC are currently out of sync. That is, the Plan identifies goals and policies that outline an approach, which could improve Chinook salmon habitat/water quality, but the LDC does not yet provide the specific language to implement the Plan. The LDC does address, though inadequately, some of the relevant habitat issues. The LDC will be updated after both the City's Statewide Goal 5 project effort and this ESA Salmon Response Plan are completed.

**Citizen Behavior**

There are citizen behaviors and activities that are identified and associated with water quality. Not all the activities have the same degree of impact, but they can result in stream contamination and further contribute to Chinook salmon habitat degradation. The following list represents some of these activities:

- Upkeep and maintenance of landscapes and yards. Activities such as mowing, pruning and improper disposal of yard debris can impact streams;

- Application of chemical insecticides, herbicides and fertilizers to landscape vegetation;
- Auto maintenance in driveways where oil, fluids and grease spills or improper disposal of these liquids can enter the streams;
- Excessive irrigation can wash contaminants into streams;
- Wash down of impervious surfaces; and
- Replacement of native with non-native vegetation.

## CONCLUSION

It is clear from this examination that City activities, through any of the identified pathways, can have a negative impact on the streams in the project area. The greatest impacts come from impervious surface, followed by riparian buffer changes and stream channelization. Impervious surface results not from just the construction of buildings, streets, and parking areas, but also from such seemingly benign activities as trails, lawns, and parks. Stormwater runoff from urban development in the upper reaches of Corvallis streams (Dixon, Oak, and Dunawi) is likely to have the greatest negative impact on water quality. The lower reaches of these streams are already incised while the upper reaches still retain a great deal of function and hydrologic connectivity. This may change as these areas experience development and increases in impervious surface that will accelerate stream incision, diminish buffer and riparian connectivity, and channel larger volumes of water at higher velocities downstream.

The City has examined and identified City activities and citizen behaviors that negatively affect Chinook salmon habitat/water quality. They understand their impacts and spatial distribution. In the next chapter pro-active steps are identified that the City proposes to take to avoid, minimize or reduce the negative impacts and where possible reverse or improve Chinook salmon habitat and water quality.

# CHAPTER 7. PROPOSED LIMIT 12 PROGRAM SOLUTIONS

## INTRODUCTION

Based on the analysis of impacts to Chinook salmon habitat and water quality from City of Corvallis activities and citizen behaviors, which is described in the previous chapter, the City has proposed solutions that prevent future habitat degradation and initiate restoration of PFC. When combined into a single program the proposed solutions meet the intent of the ESA Section 4(d) Rule Limit 12 (Municipal, Residential, Commercial, and Industrial Development and Redevelopment) objectives.

This chapter identifies the proposed solution options. It describes the process used to identify solution options, the justification for the solutions, the solution option refinement process, and the list of solution options. It details each solution and the impacts they are designed to address. It also identifies which Limit 12 criterion the selected solution will meet since most individual solutions do not meet all 12 considerations listed under Limit 12 of the 4(d) Rules (see Appendix 1 for the NOAA Fisheries guidance binder on 4(d) Rules compliance).

It is important to emphasize, however, that the program solutions have not been finalized. Other City environmental, planning and program activities identified in previous chapters are still under development (e.g., Goal 5 process Natural Features Inventory, stormwater management implementation program, Comprehensive Plan and LDC updates). It is the City's intention to integrate the ESA Salmon Response Plan program solutions into the City's practices, policies and codes as they are modified through these processes.

## SOLUTION OPTION IDENTIFICATION PROCESS OVERVIEW

The following is an overview of the process used to identify the solution options. It begins with an evaluation of the impacts from City activities and citizen behavior on Chinook salmon habitat/water quality. This involves the determination of the relative impact and ranking of the activities and behaviors on habitat done with the weighted database. It is followed by solution option identification where the project team and the community developed solution options that prevent future habitat degradation and initiate restoration of PFC. An important part of the options development process is the extensive refinement that involved stakeholders and the public. The process overview concludes with a brief discussion of how the final set of solution options was selected.

### Identifying and Ranking City Activity and Citizen Behavior Impacts

The identified solution options resulted from the integration of the baseline conditions database and pathways database developed in Phase I into a single relational database in Phase II. Weighting factors were developed because different City activities and behaviors have relatively different impacts on Chinook salmon habitat. These weighting factors, when applied to City activities and citizen behaviors, allowed the project team to analyze the spatial distribution and relative differences of impact that City activities and citizen behaviors have on Chinook salmon habitat/water quality. The project team found that the impacts ranged from positive (decreased or prevented habitat degradation) to negative (increased habitat degradation).

Since the purpose of the project is to prevent habitat degradation, attention was focused on those activities and behaviors that negatively impact Chinook salmon habitat and water quality. Using the database it is then possible to identify not only which activity and behavior negatively impacts Chinook salmon habitat and its distribution (reach, stormwater basin, creek, citywide, and UGB), but it is also possible to determine the relative negative impact of the activity as well.

A rank-ordered list was developed that grouped together activities and behaviors with similar weighted scores. Those with higher negative scores were considered to have a greater negative impact on Chinook salmon habitat and from a policy standpoint were presumably of higher priority to correct than other activities and behaviors with lower negative scores.

An extensive review process was used to ensure the accuracy of the list and ranking. The review process included an internal project team review as well as a peer review process with the Technical Advisory Committee (TAC). Where necessary, refinements, modifications and corrections were made to the database to better reflect the impact of the City activity and citizen behavior.

Finally, the activities and behaviors were compared to a set of criteria to determine their relative impact to Chinook salmon habitat and water quality based on their magnitude, timing and intensity. A number that best represented the activity's magnitude, timing and intensity was assigned to the activity and behavior. These numbers were summed and then multiplied by a number that represented their location inside or outside the 200-foot study corridor. Activities were then ranked according to their final score, which represented the activity's impact to Chinook salmon habitat and water quality (see previous chapter for detailed discussion of this evaluation process).

**Solution Options Identification Process**

After review of the ranked order of activities and citizen behaviors, the project team began the solution option identification process. This process was completed in three steps – 1) selecting activities with the greatest negative values, 2) evaluating potential adjustments or changes to selected activities, and 3) developing solution options.

*Select Activities*

The City activities that contribute to Chinook habitat and water quality degradation come primarily from City Departments responsible for parks and recreation, transportation, utilities, and land use planning. They cover land development, roads, buildings, pipeline construction and utility service facilities, as well as the operation and maintenance activities to service and maintain them. Planning policies, along with the supporting LDC, are the guidelines and directions for the City's growth and development and the public services that are needed to support it.

The first stage in the selection process was to identify those activities with the greatest negative score. The team reviewed all activities with negative scores. There were 1,710 records with negative scores ranging from -1 (least negative impact on Chinook salmon habitat and water quality) to -60 (highest negative impact on habitat and water quality). The initial determination was to include all activities with negative scores. The rationale to do so was based on the idea that in the initial screening it would be important to recognize that all negative scores indicated that the activity had a negative impact on habitat and water quality. In later stages of the screening process, there would be an opportunity to screen out activities with a lesser negative impact and focus on those that had a greater impact on habitat and water quality.

The second stage was to organize the records in a way that would be useful for developing solution options. Since there were so many records it was necessary to create practical categories for solution development. One way was to group them by similarity (e.g., purpose, function, department, etc.) since many of the records in the database covered a specific detail or single aspect of the same activity. The following categories were used to group the activities:

- Land use
    - Zoning
    - Land Development Code
- Parks and recreation
    - Planning and design
    - Capital improvements
    - Operation and maintenance
- Stormwater
    - Operation and maintenance
    - Run-off collection, treatment, and discharge
    - Capital improvements
- Construction of public projects
    - On-site construction requirements
- Transportation
    - Operation and maintenance
    - Capital improvements

- Water supply
    - o Operation and maintenance
    - o Capital improvements
- Wastewater treatment
    - o Operation and maintenance
    - o Capital improvements

The citizen behavior activities were organized differently. Similar activities were categorized based on whether they were indoor or outdoor, landscape or other maintenance. The citizen behavior activities were grouped in the following manner:

- Household
    - o Indoor cleaning and upkeep
- Outside
    - o Yard maintenance
    - o Landscaping
    - o Other outdoor maintenance other than yard.

*Develop Solution Options*

Once the records were organized according to the categories, a third stage was initiated to identify solution options. The initial screen involved examining each category to determine whether there were already other programs underway or planned that could also address the project's Chinook salmon habitat and water quality issues. If so, the project would avoid any overlapping and duplication of effort by simply contributing to these ongoing or planned programs.

The screening discovered several programs currently in various stages of development and implementation that did have some overlap with the existing ESA categories. They included the following:

- Statewide Goal 5 Inventory (Natural Resource, Scenic and Historic Areas and Open Space Goal – OAR 660-015-0000(5))
- Land Development Code update (Phase II)
- Stormwater Master Plan implementation

Where ESA categories matched other programs, the project team reviewed them to identify how well they considered ESA issues and to identify where additional ESA recommendations could be made to the existing program. ESA categories that did not match ongoing efforts were considered wide open to begin to develop options targeted to specifically address Chinook salmon habitat and water quality.

First Solution Option Identification

The first cut at solution options identification was unconstrained by cost or other parameters. This allowed for the most creative and far-reaching possibilities to be explored. In a number of instances elements of an option that would otherwise not have been identified were selected and incorporated into the viable options.

The following is a summary of the options identified in this first screening.

- Land Use.
  - Create new zoning categories (e.g., stream corridor, conservation open space).
  - Fully protect portions of the stream corridor that are deemed Significant Natural Features.
  - Support LDC updates to incorporate Chinook salmon habitat protection design standards.
  - Prevent any future development within the 100-year flood plain and provide incentives to remove existing development within the 100-year flood plain.
  - Contribute to the City's effort to meet Statewide Goal 5 planning requirements with Chinook salmon habitat data and protection options.
  - Ensure consistency with other planning efforts (e.g., parks and recreation planning, utility master planning, transportation planning).
  - Incorporate planning concepts that reduce transportation trip generation and need for more roads (e.g., mixed use, higher residential density, alternative transportation modes, etc.).
- Parks and Recreation.
  - Design future parks and open space facilities to consider site location and incorporate "fish-friendly" elements (stream corridors, riparian areas, connectivity, vegetation, etc.).
  - Inventory parks facilities to assess how they currently fit ESA goals and identify and design modifications to meet these goals where they do not.
  - Partner with non-profit organizations to purchase and set aside land to meet ESA goals.
  - Prepare an Operations and Maintenance Manual outlining operations and maintenance for each park.
  - Site wood chip pile elsewhere with appropriate run-off controls in place and do not accept third party organic debris.

- Stormwater.
  - Incorporate stormwater protection criteria into the LDC and Design Criteria Manual.
  - Incorporate erosion control requirements into the LDC for public and private projects.
  - Implement applicable master plan recommendations to meet ESA goals.
  - Develop operations and maintenance manual that incorporates ESA goals.
- Public Construction.
  - Require waste materials disposal plan for approval by City construction engineer.
  - Require City to monitor construction site for construction activities that can degrade Chinook salmon habitat and water quality.
  - Memorialize changes in site construction requirements through city ordinance.
  - Add requirements in the Standard Construction Specifications (SCS) for construction site activities including the recycling of construction site materials, prohibiting clean-up activities (e.g., concrete wash down and disposal, asphalt clean up, etc.), de-chlorination, dewatering, erosion control, eco-friendly construction materials, etc.).
  - Strive to meet Leadership in Energy & Environmental Design (LEED) standard specifications for City buildings (City is currently reviewing specs for compatibility and practical use).
- Transportation.
  - Incorporate ESA goals into future transportation planning activities (e.g., adapt "green streets" concepts, transportation demand management, non-motorized transportation alternatives, minimize stream crossings, consider sensitivity to stream corridors and placement of transportation facilities).
  - Integrate transportation planning with land use planning to ensure that there is consistency in the application of ESA goals.
  - Revise transportation system plan to incorporate ESA goals.
  - Incorporate ESA goals into future transportation design activities (e.g., minimize proximity of streets, pedestrian and bike paths, bike and car parking areas to stream corridors; design "fish-friendly" bridge crossings; use "fish-friendly" construction materials).
  - Encourage businesses to provide employee bus-passes, provide bike parking, and encourage car/van pooling, off-peak hours and telecommuting.

- Modify operations and maintenance activities to reduce impact on Chinook salmon habitat and water quality (e.g., airport maintenance, grading/sweeping, vegetation maintenance, chemical application, vehicle maintenance).

- Water Supply.
  - Add fish screens at water supply intakes.
  - Promote water conservation measures (public, private businesses and residents).
  - Adjust rates to regulate water consumption.
- Wastewater Treatment.
  - Promote planning activities that will reduce impact to Chinook salmon habitat (e.g., increase capacity of pump stations to reduce likelihood of overflows).
  - Develop a spill prevention program.
  - Require discharges from certain businesses to be pre-treated before discharge.
  - Investigate use of pump stations instead of gravity systems near waterways and high groundwater areas.
  - Incorporate operations and maintenance activities that minimize impacts to streams.
  - Consider grey water separation to decrease flow to wastewater treatment plant and to conserve water.

Similarly, for citizen behavior the following options were identified.

- Encourage appropriate vehicle maintenance activities (spill prevention, clean-up and disposal, etc.).
- Promote proper landscaping, yard care and pollution prevention techniques (disposal of yard waste, recycling, application of fertilizers, herbicides and pesticides, etc.).
- Encourage vehicle trip reduction through employee transportation coordination and use of alternative transportation modes.
- Promote water conservation activities to reduce water consumption (e.g., recycling, appliance purchase rebates).
- Develop program to educate citizens about salmon habitat protection and how they can contribute (schools, media, etc.).

Public Review

Once the initial options list was developed in the Fall of 2002, the City began a series of public reviews that culminated with a public open house/workshop on November 19, 2002 and a website-based questionnaire. The purpose of these actions was three-fold. First, they were designed so the public could review and comment on the solution options that were identified. Second, they were designed to solicit additional options from the public. Third, they were used to gauge public acceptability and support for the solution options.

Two stakeholder meetings (October 2 and 9, 2002) were held prior to the second public open house/workshop. The stakeholders were identified from contacting environmental organizations (The Environmental Center, Mary's River Watershed Council) business organizations (Corvallis Chamber of Commerce), institutions (Oregon State University) and interested people who had registered for future contact at previous public meetings.

After a project update and overview, stakeholders were presented with the draft options and then encouraged to ask questions and comment on them, as well as identify other options or variations on the solution options. The stakeholders identified variations to the solutions options and suggested specific ways to apply the options.

The second public event (the first was held May 2001) was an open house/work shop (November 19, 2002). Attendees were presented with the options and then divided into groups to carefully review, comment on and add/modify the solution options (e.g., land use, parks and recreation, utilities, construction specifications, transportation, citizen behavior). The options were ranked in order of effectiveness to prevent Chinook salmon habitat degradation. At the end of the meeting participants were also asked to rank the options themselves based on how they perceived the City should prioritize its ESA planning efforts. A questionnaire was distributed to the attendees for that purpose.

This questionnaire was also posted for three weeks on the City's ESA project website so that persons who did not attend the public meeting could submit rankings (See Appendix 14 for copy of 11/19/03 website questionnaire). The questionnaire also included space to add comments on the options.

The first phase of review closed with the project team collecting all comments, questionnaires, and proposed new options and option modifications. Based on these inputs and those from City staff and the TAC, the project team began refining the options.

*Option Refinement and Public Review*

A revised set of options was prepared that incorporated the comments from the public, City staff and the TAC. Three new elements were included in the revisions. First, each solution option was screened to identify which of the 12 considerations under ESA Section 4(d) Rule Limit 12 (Municipal, Residential, Commercial and Industrial development activities) the solution met. Second, timing for implementation of the option was identified to give an idea of the lead-time and staging that might be necessary to put the option into action. Third, where possible, implementation costs were calculated.

The TAC was given several additional opportunities to review and comment on the revised options. Only minor modifications were necessary to prepare them for a final round of public comment.

The final draft set of options with revisions was presented to the public at an open house/workshop meeting on June 4, 2003. This event was similar in format to the one held on November 19, 2002. After review of the options and the modifications made based on the previous comments, the public divided into groups to carefully review the options and provide further comments and modifications. The options were listed in order of effectiveness toward preventing Chinook salmon habitat degradation. Meeting participants were again asked to fill out a survey questionnaire and provide comments based on the revised options and to change the ranking if they disagreed with the order.

The same questionnaire and comment form was posted on the City's ESA project website for four weeks to allow persons who did not attend the public meeting an opportunity to comment on the options (See Appendix 15 for copy of web-site questionnaire). Once the website questionnaire and comment form was closed, the project team assessed the public review comments and began developing the final draft solution options.

**Recommended Solution Options**

The following are the recommended solution options. They are presented by category and represent solutions that should prevent Chinook salmon habitat degradation and in many instances begin the process of restoring PFC. The solution options should also improve water quality, which is the most important factor in fish habitat in the Corvallis watershed. See also Appendix 9 for detailed tables of the solution options including cost estimates where it has been feasible to identify them.

Accompanying the solution options is Table 3. The table lists the solution options and indicates which of the 12 considerations under ESA Section 4(d) Rule Limit 12 the solution option meets. In some cases the solution option meets all considerations. In others the solution options meet only a few. The importance of the table is to demonstrate that the solution options when taken altogether meet all 12 considerations that are required of ESA Section 4(d) Limit 12. Not only will a program that includes these solution options comply with Limit 12, they will be effective in preventing habitat degradation and restoring PFC.

*Land Use Solution Options*

Zoning

Several options address changes in zoning designations that affect future land use and result in protecting Chinook salmon habitat. Some of the proposed zoning solution options are being considered under the Phase III planning effort currently underway at the City's Community Development Department. Timing for Phase III implementation is scheduled for the end of 2004.

The major components of the zoning solution options are the following.

- Protect portions of stream corridor(s) that are deemed critical to preserve Chinook salmon habitat and water quality from development through zoning. The following are examples:
  - Create protection zones and apply them at specific locations to protect habitat and water quality.
  - Create an overlay zone designed to protect Chinook salmon and water quality.
- Zoning and Open Space
  - Increase open space requirements for all zones.
- Density transfers for development:
  - Allow density transfers to increase open space.
  - Allow density transfers on-site to protect selected resource areas.
- Use resource information from Corvallis' Statewide Goals 5 (Open Spaces, Scenic and Historic Areas and Natural Resources), 6 (Air, Water and Land Resources Quality) and 7 (areas subject to Natural Disasters and Hazards) compliance projects to craft ESA protection policies and actions.
- Limit uses within zones:
  - Uses within stream corridors or on specific reaches or watersheds would have limited use depending on location.

<u>Land Use Development Standards</u>

Solution options are also proposed for development standards. Development standards are part of the City's LDC, which is currently being updated as part of the Phase III planning effort. Like the timing for zoning, the City intends to complete update of the LDC by the end of 2004.

The following lists the major components of proposed development standard solution options.

- Standards to decrease impervious surface. One of the biggest contributors to Chinook salmon habitat degradation is stormwater run-off from impervious surface. One method to reduce the volume of run-off is to consider reductions in the amount of impervious surface allowed in land development. The following are a few examples:
  - Reduce parking maximums where transit is available.
  - Require an increase in bicycle parking to encourage riding and reduce vehicle trips.
  - Encourage pervious pavement.

- Reduce base ratios for auto parking.
- Modify street design standards.
  - Reduce street widths (not below emergency access widths).
  - Require bike lanes.
  - Allow one-sided street parking.
  - Incorporate "green street" design standards (e.g., use planting strips/swales for stormwater treatment).
- Require and provide incentives for vegetation protection.
  - Vegetation can be used as an effective buffer (see below) between stream corridors and development.
  - Landscaping with native species will also help reduce the impact to habitat.
- Buffer areas.
  - Adjust buffer requirements depending on the habitat quality of a specific reach. High quality reaches would have more restrictive development standards than low quality reaches in order to protect and prevent them from becoming degraded.
  - Apply greater mitigation requirements in lower quality reaches in order to prevent further degradation.
- Dedications and easements to protect riparian function.
  - Develop a formula-based approach to determine the size/width of an easement.
- Develop specific design standards for stream crossings.
  - Identify appropriate locations for stream crossings to minimize impact to water quality and fish habitat.
- Provide incentives (e.g., density transfers) to remove development within the 100-year flood plain.
- Require development standards that address wetland and other sensitive areas/lands.
- Create specific land use standards that address Chinook salmon refuge areas, if necessary.
- Prepare land development standards that are specific to the Mary's River area to take account of the unique habitat features of the river.

*Parks and Recreation Solution Options*

The City has a significant amount of land devoted to park and recreational facilities. Park acreage is approximately 1,439 acres of which 1,100 acres are designated open space lands. Many of these park facilities are adjacent to or along streams where park development and operation and maintenance activities can impact the quality of Chinook salmon habitat and water quality. Even park facilities that are not along streams have some potential to impact fish habitat and water quality.

The proposed solution options cover a wide range of parks and recreation activities. The activities include future park, open space, and recreational planning; specific park and recreation facility improvements; and park and recreation facility operations and maintenance. Timing for implementing the solution options varies depending on the activity and the Department's ability to fund the solutions.

<u>Neighborhood Park Planning</u>

A number of recommended solution options were suggested for neighborhood park facility planning. The following specific options are proposed:

- Develop new park siting, planning, and design criteria that address Chinook salmon habitat and water quality. Some examples follow:
    - Incorporate water quality sensitive design.
    - Use eco-friendly design materials (e.g., pervious pavement for trails and parking lots).
    - Site park facilities where impacts are lower.
    - Maintain surface and sub-surface flows by decreasing the amount of impervious surface, compaction and contaminants.
    - Site active recreation parks outside stream corridors.
    - Limit corridor crossings with culverts.
    - Develop park programs that balance recreation and environmental stewardship.
    - Have goals that reflect sensitivity towards ESA, fish and wildlife needs, and water quality.
    - Maintain composition and overstory cover (tree cover).
    - Maintain composition and understory cover (shrub/herbaceous layer).
    - Maintain historic water flow and hydrology where parks are adjacent to streams.
    - Minimize the need for additional stormwater treatment with proper facility design.
    - Plant native species where appropriate for mitigation and park plant community.

- Continue park policy of "right plant, right location."
- Place parks on one-side of the creek or use bridges that span the entire creek (no in water bents) to minimize impacts.
- Maintain stream corridors by designing to minimize their impact.
- Develop partnerships to acquire land or conservation easements that can be preserved as open space.

Open Space and Recreation Service Planning

Since the City is responsible for over 1,000 acres of park lands designated as open space, there is a need to address how to manage the open space as it pertains to Chinook salmon habitat and water quality. The City recognizes its role as steward for this open space and has begun developing an Open Space and Recreation Service Plan that addresses among other issues impacts on habitat and water quality. Plan development is currently underway with the Owens Farm property (located adjacent to the Jackson-Frazer Wetland) and will be expanded to other open space lands once a methodology for developing an open space plan is worked out.

Operations and Maintenance

Operations and maintenance activities can have some of the most direct impacts on fish habitat. Maintenance for parks along City streams and rivers (Willamette Park, Crystal Lakes Sports Fields/Kendall Natural Area, MLK/Berg Park, Riverfront Commemorative Park, Avery Park, etc.) have the potential to degrade habitat if not conducted properly. The following options have been identified to help reduce habitat degradation. The timing for implementing these solutions will vary depending on the availability of the budget.

- Prepare an Operations and Maintenance Manual to provide guidance for the entire parks system.
    - The Operations and Maintenance Manual would be site- and season-specific and provide guidance for all site operations and maintenance activities (e.g., vegetation maintenance, mowing, fertilizer and herbicide/pesticide applications, etc.).
    - Map parks and identify locations where specific activities may and may not take place.
- Maintenance for nearly all park and recreation equipment is performed at Avery Park. Since this park is located adjacent to the Mary's River, maintenance activities, if proper precautions are not taken, could potentially impact the river.
    - Provide guidance for the Avery Park maintenance facility, which includes containment and treatment of equipment wash-down and run-off liquids.
    - Develop a spill prevention program.

- Properly dispose of liquids and materials used for maintenance.
- Provide an appropriate facility for storing chemicals and liquids.

Existing Park and Recreational Facilities

While planning can address future park and recreational facility development, existing parks have the potential to impact Chinook salmon habitat and water quality. The following solution options are directed toward addressing the City's existing park and recreation facilities.

- Inventory existing park and recreational facilities (e.g., activities, programs, structures, locations, and operations and maintenance practices) and assess how they fit with ESA goals.
  - Determine what modifications are needed to minimize impact to fish habitat and water quality.
- Existing park and recreation solution options.
  - Mitigate activities on-site by removing/replacing structures and impervious surfaces with low environmental impact materials.
  - Retro fit and mitigate impacts with low impact design and materials.
  - Identify parks located in sensitive and riparian areas and determine mitigation needs.
  - Implement agriculture conservation plans where agriculture leases and service agreements exist.
  - Time construction to minimize erosion and sediment transfer, soil compaction, and impact to Chinook salmon habitat.
  - Use Best Management Practices (BMPs) to maintain low impact.
- BMX Track (bike park).
  - Retro fit and mitigate BMX park or move it to reduce impact on stream water quality and fish habitat.
  - Remove creosote posts.
  - Remove paved access ramp and boat structures.
- Timberhill School Park.
  - Restore wetland and mitigate drainage impacts.

- Mary's River Natural Park.
  - Install floating dock to minimize impacts.
  - Use low impact materials for facilities and structures.
- Bruce Starker Park.
  - Implement management strategy to minimize impact of ornamental pond on adjacent streams (chemicals in water have been discharged).
  - Treat discharge of stormwater (install oil separator).
  - Redesign and relocate parking lot so as not to be so close to stream.
- Wood chip pile run-off and containment (located at Avery Park) – several options.
  - #1: Develop methods to capture, treat, and discharge run-off from organic debris at existing location.
  - #2: Move the pile elsewhere to prevent discharge to Mary's River (e.g., move to Process Recovery Center).
  - #3: Reduce, restrict, or eliminate third-party organic debris to reduce potential liquid run-off.

*Stormwater Run-off Solution Options*

It has been determined that one of the main pathways contributing to Chinook salmon habitat and water quality degradation is stormwater run-off. The City recognizes that stormwater run-off can be a problem and has taken a number of steps recently to help reduce its impact through planning efforts and projects such as the City's successful stormwater collection, treatment and discharge project in its urban core (combined sewer overflow project). The ESA project team has carefully reviewed these efforts and has proposed solution options that capitalize on ongoing stormwater management efforts as well as proposed additional solutions that will further reduce negative impacts to Chinook salmon habitat and water quality. Some of the options are incorporated into ongoing stormwater projects, while other options will be included in future planning and capital improvement efforts.

<u>Stormwater Planning</u>

Control of stormwater begins with planning where it is possible to assess current conditions and forecast future conditions that incorporate such factors as population growth and the spatial distribution of land use development. From these planning efforts the City can assess ways to manage future stormwater run-off. The City has undertaken just such an effort over the past six years with development of its Stormwater Master Plan (SWMP). They have crafted major policies and identified projects that will address the City's stormwater.

The ESA project was initiated after the SWMP was well underway, but the City was extremely interested in integrating the SWMP with the ESA. The ESA project team carefully reviewed the working documents for the SWMP and provided information, as it was available, to members of the SWMP committee. From these interactions the following proposed solutions options were crafted.

- Integrate SWMP into ESA program.
    - General policies to integrate into the ESA program are in Chapter 5 of the SWMP. The policies include maintaining natural hydrologic processes, protecting and restoring natural resources and ecosystem functions; protecting and improving water quality; addressing maintenance requirements and allowing for maintenance access; incorporating community awareness and information exchange.
    - SWMP recognizes the need to integrate the SWMP policies with the ESA program through application of SWMP policies to Municipal, Residential, Commercial, and Industrial (MRCI) development, which is ESA Section 4(d) Rule Limit 12.
- Integrate specific SWMP actions into ESA program that do the following:
    - Provide sediment and erosion control requirements to reduce erosion and sediment transfer.
    - Reduce contaminant transfer to surface and groundwater.
    - Enhance native vegetation along riparian areas to maintain connectivity, filtering pollutants, provide shade, and maintain buffer.
    - Protect and enhance stream channels.
    - Protect uplands and wetlands.
    - Manage floodplains to protect development but also to maintain fish habitat.
    - Restore streams to properly functioning condition.
- Erosion Control Ordinance
    - Pass and implement Erosion Control Ordinance
- Operations and Maintenance
    - Develop stormwater operations and maintenance management plan (this is Phase II of the U.S. Environmental Protection Agency's stormwater discharge permit requirement).
- Monitoring stormwater
    - Develop stormwater monitoring plan to measure improvement in water quality in streams and creeks over time and incorporate ESA goals for preventing Chinook salmon habitat degradation.

- o Focus on two elements in the monitoring program: on-site monitoring and programmatic monitoring. On-site monitoring will require taking actual site (field) measurements to determine effectiveness of program goals. Programmatic monitoring will assess how the implemented activities meet ESA goals.
- o Incorporate steps and procedures for corrective actions where program does not meet improvement criteria.
- o Develop community awareness and recognition that ESA salmon recovery is a long-term commitment. Changes in the landscape and water quality will take considerable time to accomplish.

*Public Construction Specifications Solution Options*

It is considered important that the City take the lead in demonstrating how to meet the ESA project goals of preventing further Chinook salmon habitat degradation and initiation of PFC restoration. All public construction must comply with the City's construction specifications. The project team reviewed the existing public construction specifications to identify solution options that could meet the ESA goals. In addition to actual construction, the project team has reviewed the City's commitment to sustainable development practices. The following solution options that were identified to meet the ESA goals range from job site activities and enforcement to long-term sustainability practices.

<u>Onsite Construction Activities</u>

The concerns with the job site are construction activities that may have off-site impacts. Not only do equipment clean up and materials disposal practices have the potential to impact nearby streams and riparian areas, but also the construction materials themselves can have long-term impacts. The following are on-site solution options that primarily address clean up and construction practices. The next section on sustainability addresses construction materials.

- Require contractor to prepare a construction site plan that addresses:
  - o Appropriate disposal of construction materials (concrete, soil, construction materials).
  - o Mitigation of impacts should plan fail and damage occurs off-site.
  - o Appropriate disposal of demolition materials.
  - o Monitoring plan to assure compliance.
  - o Proper pipe flushing activities.
- On-site hazardous materials.
  - o Proper use and disposal of construction related hazardous materials. Dispose of hazardous materials in a manner that does not impact water quality and salmonid habitat.

- o Require specific clean up practices for solvent materials that are used at the construction site.
- Erosion control.
  - o Specify appropriate erosion control practices (see erosion control option in stormwater solution options).
  - o Containment of pollution run-off (e.g., stormwater, wash-down, etc.).
  - o Minimize contaminates at job site from entering streams and groundwater.
- Monitoring and enforcement of construction site plan: two methods.
  - o Contractor or materials supplier performs monitoring and self-enforcement.
  - o City performs monitoring and enforcement.

Sustainability

Sustainability has become an increasingly important element in development. Both public agencies and private developers are recognizing the benefits of developing projects that support environmentally sustainable concepts. One way to encourage the adoption of sustainable development practices by the private sector is for the City to use the concepts in its own construction. Another way to encourage private business to adopt sustainability in private development is to create incentives for the private sector to support sustainable development.

Sustainability with respect to protection of Chinook salmon habitat and water quality ranges from siting of facilities and use of construction materials to the actual design of a facility. The following solution options identify sustainability practices that can positively impact Chinook salmon habitat and water quality.

- Encourage construction in the City to meet LEED standards (Leadership in Energy and Environmental Design). Corvallis is currently using LEED for some of its own building practices, but these practices should be expanded to encourage incorporation of LEED in private land development and construction.
- Require "eco-friendly", low impact materials and recycling practices.
- Encourage use of materials that would reduce impact on environment, including paints, construction materials, etc.
- Consider providing a list of products that are accepted/prohibited or, alternatively, the City should define "fish friendly" criteria that contractors/suppliers can use to determine what construction materials qualify.
- Incorporate construction-siting criteria that reduce negative impacts on water quality and fish habitat (e.g., building placement, buffer areas, utility location, drainage way location, etc.).

*Transportation Solution Options*

Transportation (e.g., roadway network, bridges, bike and pedestrian pathways, transit, etc.) plays a critical role in almost all City activities. It is principally through the transportation network that residents and businesses connect and interact. Freight is transported, residents commute to work, to shop, and to recreate.

The transportation network is both large and pervasive. The facilities that are needed to support the network can have negative impacts on the environment including Chinook salmon habitat and water quality in streams. The purpose for identifying transportation solution options is to help minimize their negative impact through planning, project construction, and maintenance and operation activities. By incorporating the proposed solutions it will be possible to prevent further Chinook salmon habitat degradation and water quality impacts to city streams.

The solution options are divided in to three main categories — planning, design, and operations and maintenance. Transportation planning covers solutions that will help future transportation network development. Design will address projects to be constructed. Operations and maintenance addresses current and future impacts to Chinook salmon habitat and water quality.

<u>Transportation Planning</u>

While planning for transportation facilities is closely tied to the City's comprehensive planning efforts, determining exactly what type of transportation facilities will be needed is in part the role of the Transportation System Plan (TSP). In that capacity the TSP can address not only the types of transportation facilities to provide, but also the way they are delivered. Issues such as timing, location, design and even materials that are used can be addressed in transportation planning policies. Therefore, transportation planning is an important method of preventing future Chinook salmon habitat degradation as policies can be identified to meet ESA goals.

What follows are solution options that cover future transportation facilities. The options range from proposed policy changes to more specific design related planning.

- Incorporate ESA goals into the Transportation System Plan (TSP).
    - Review the TSP to make sure specifications incorporate habitat and water quality considerations.
    - Revise proposed projects to meet habitat and water quality requirements.
- TSP policy planning should address the following:
    - Minimize proximity of streets, pedestrian and bike paths, and parking areas to streams, creeks, water bodies and wetlands.

- Minimize impacts caused by proximity of transportation facilities to streams and water bodies through design and materials used.
- Minimize stream crossings. Where bridges are needed use open bottom structures instead of culverts and span entire streams to reduce the number of structures in streams.

- Transportation Demand Management (TDM) Strategies.
    - Identify and implement strategies in the 1995 Transportation Alternatives Study to help improve water quality, reduce stormwater run-off, and reduce impervious surface cover.
    - Reduce private vehicle trip generation by encouraging alternative transportation methods (bike, bus, carpooling, pedestrian, walking).
    - Encourage telecommuting.
    - Recommend reduction in vehicle miles traveled (VMT). As a member of the Corvallis Area Metropolitan Planning Organization (CAMPO) The City can now implement programs that encourage VMT reduction.

Transportation Design

The project team proposed solution options that can be incorporated into project design. The following solution options address specific design elements that will help prevent Chinook salmon habitat degradation. Many of these options come from the so-called Green Street design elements that address methods to meet important transportation network goals through low impact transportation improvement designs.

- Capital Improvement Plan (CIP).
    - Incorporate low impact design into CIP transportation projects.
    - Incorporate SWMP policies as part of the evaluation criteria to determine applicable low impact design elements.
- Consider incorporating the following design elements into future transportation projects. These design elements could become part of the updated TSP.
    - Modify existing street widths based on street classifications (e.g., one-side parking, one-side sidewalks).
    - Consider bio-swales and other vegetative buffers to prevent run-off to streams along streets and in parking lots.
    - Consider alternative materials (e.g., pervious materials, vegetation, etc.) in project designs.
    - Consider vegetation planting wherever possible to reduce temperature and evaporation.

- Incorporate capture and treatment techniques to reduce the impact of stormwater run-off.
- Reduce the City's current off-street parking space ratio from 1:400 square feet of floor space to 1:1,000 square feet of floor space.
- Use concrete instead of asphalt to reduce run-off temperature.

Street Operation and Maintenance

The City's transportation operation and maintenance activities are quite advanced. Many operation and maintenance activities already minimize impacts to streams. The City is considering a similar application to NOAA Fisheries for an ESA Section 4(d) Rule Limit specifically for its transportation operation and maintenance practices. Limit 10 of the Section 4(d) Rule covers Routine Road Maintenance Activities. Like Limit 12, if approved by NOAA Fisheries, the operation and maintenance activities performed by the City's transportation division will be certified as protecting Chinook salmon habitat.

A letter from NOAA Fisheries dated January 7, 2002, which addressed Phase I of Corvallis' ESA project, encouraged the City to consider submitting a Limit 10 application. In part the letter noted "we [NOAA Fisheries] recommend the city consider submitting an application under the 4(d) limit for your road maintenance program (Limit 10)."

Further, the letter from NOAA Fisheries acknowledged that the level of effort to obtain approval for a Limit 10 is less arduous than for a Limit 12. While the Limit 12 may cover a broader number of activities, the Limit 10 is a good start to meeting the ESA requirements for Chinook salmon habitat preservation.

*Water Supply Solution Options*

Water supply impacts on Chinook salmon habitat typically occur in three ways. First, there is the raw water intake where water is pumped from the Willamette River to eventually be delivered to the user. Second, there is the consumption of the water by the user. Third there are the activities that the City must perform to maintain the water supply system.

In the first instance, water withdraw from the river has the potential to result in a direct take of Chinook salmon should they be sucked into the raw water intake. In the second instance, there is a potential of indirect take if water applied to land acts as a pathway for contaminants such as lawn fertilizer, to enter a stream and degrade Chinook salmon habitat. Finally, in the third instance there are maintenance activities such as waterline flushing that can result in habitat impacts. All three can violate the ESA for listed Chinook salmon.

Fortunately, the City has already undertaken efforts to eliminate take at the City's raw water intake. The City installed a NOAA Fisheries approved water diversion fish screen to reduce the possibility that Chinook salmon will enter the water intake. An approved water diversion screen by NOAA Fisheries complies with ESA Section 4(d) Rule Limit 9. Limit 9 specifically addresses water intakes and appropriate screening to prevent the take of listed fish.

With respect to the second and third areas of potential impact there are a number of potential solution options that can help reduce habitat degradation. The following options have been proposed to address water consumption and system maintenance.

Water Consumption

Reducing water consumption can be a way to lower the potential impact on Chinook salmon habitat. A reduction in water demand will lower water needs for the Corvallis system, which in turn will reduce the risk of a take at the City's water intake and leave more water in the Willamette River. Water conservation may also result in a reduction of the need for water to be applied to landscaping and other land features, which can lead to Chinook salmon habitat impacts. The following proposed options address ways to encourage water conservation.

- Conservation measures.
    - Encourage public and private business conservation measures to reduce water consumption through education programs.
    - Use inclining rates to reduce water consumption.
    - Investigate the use of appliance rebates to encourage conservation.
    - Encourage use of native vegetation to reduce irrigation needs.

Operation and Maintenance

The City must maintain its water supply system. Most operations and maintenance activities already prevent impacts to streams. A few additional solution options have been proposed that will further reduce impacts.

- Consider reducing the amount of water needed for flushing the distribution system and blow-off to reduce water supply demand.
- Quickly replace or repair broken or damaged pipelines.
- Provide secondary containment for spills that could contaminant streams.
- De-chlorinate backwash water.

*Wastewater Treatment Solution Options*

There are a number of areas where wastewater has the potential of impacting Chinook salmon habitat. Upsets can occur and untreated wastewater can be discharged directly into the Willamette River when combined sewer and stormwater flows overwhelm the collection system and treatment facility's ability to treat the volume (fortunately, recent projects have substantially reduced the frequency of this occurrence). Gravity collection systems are often located along side streams where they can impact stream surface and underground water flows. Treated wastewater discharges have the potential to elevate receiving water temperatures. In addition, as city growth occurs there are increasing collection, treatment and discharge capacity needs to handle the growth creating potential future impacts on habitat and water quality.

The project team has identified a number of solution options that can reduce Chinook salmon habitat impacts. Like water supply, some of the solution options are related to activities that can reduce demand or the need for treatment capacity through planning and other reductions in capacity needs. Other options address maintaining the existing system so there is a lower probability of upsets or overflows.

Wastewater Collection

The following are proposed options to help reduce the potential for system upsets. They address both maintenance as well as conservation techniques.

- Increase capacity of pump stations to reduce likelihood of overflows. Install auxiliary power source.
- Disconnect stormwater drains on private and public facilities from the sanitary sewer system.
- Regular inspection of pipes to verify integrity.
- Repair or replace damaged and broken pipes.
- Flush and clean pipes to maximize capacity.
- Enforce the fats, oils, and grease (FOG) program to reduce grease build-up in pipelines, which reduce their capacity to convey wastewater.

Conservation

Conservation can help reduce wastewater treatment capacity demand. Like water supply conservation, reductions in demand can have a number of benefits to Chinook salmon habitat including lower discharge, fewer new facilities and reduced risk of system upsets. The following solution options address methods that can lead to reduced treatment capacity demand.

- Investigate use of grey water separation to decrease flow to wastewater treatment plant and to conserve water.
- Investigate wastewater reuse.
- Encourage citizen and business conservation measures to reduce wastewater discharge.

Discharge

The City has a National Pollution Discharge Elimination System (NPDES) permit that allows it to discharge treated wastewater into the Willamette River. The permit specifies the requirements for discharge including volumes, temperature, quality and allowable mass load limits. The City is seeking a renewal for the NPDES permit in 2004. During renewal the following proposed solution options should be considered for the new permit.

- Incorporate temperature requirements for Chinook salmon in upcoming NPDES permit.

*Citizen Behavior Solution Options*

Citizens should be considered partners in any ESA plan that is developed. Corvallis residents and businesses are known for their support of civic activities and environmental preservation. In many instances citizens and businesses are already incorporating behaviors that support Chinook salmon habitat and water quality. These activities include recycling, use of alternative transportation modes, telecommuting, water conservation, planting native vegetation and other low water use plants, and supporting other pollution prevention activities.

The following proposed solution options capitalize on the predisposition of citizen and local business behavior. In addition, with some strategic support by the City (using staff time to help implement some of these activities) the activities could have a noticeable impact on protecting Chinook salmon habitat.

Public Education

Informing and educating the public on the purpose and goal of protecting Chinook salmon habitat is an important step in changing citizen behavior. To be successful, though, it needs to be a coordinated program with sufficient resources to promote the educational effort. The following proposed solution options address public education outreach efforts.

- Develop a formal Public Education Plan and include the following elements:
  - Outline program and activities/elements to be used to encourage changes in public behavior.
  - Provide overall guidance and direction on public education.
  - Include program elements, milestones and evaluation criteria to measure effectiveness.
- Coordinate with other ongoing programs.
  - Use Public Works Department Water Resources Specialist to organize public education plan in coordination with other water quality initiatives.

- Use other existing programs to educate public on what they can do to contribute to preserving Chinook salmon habitat and maintaining water quality. Existing programs would include the Parks and Recreation Department's Urban Forestry program and Public Works Department's water conservation programs.
  - Prepare, print and distribute brochures on recycling and conservation.
  - Enlist other non-city organizations and programs to help educate the public (e.g., Master Gardener Program, Chamber of Commerce, Environmental Center, neighborhood associations, Mary's River Watershed Council, etc.).
- Pollution prevention program (PPP). This program has similar goals and can be a useful tool for the ESA education program.
  - Public Education Plan would reference the PPP as part of the City's overall effort.
  - Encourage both citizens and businesses to participate.
  - Existing PPP is currently being updated and expanded to meet Clean Water Act (CWA) requirements.

Incentives

Incentives can encourage voluntary participation. The following address goals that can help achieve the ESA goal.

- Support incentives to change citizen behavior. Incentive programs could be an element in the Public Education Plan. The following programs will help to reduce water demand and water quality degradation:
  - Low water use appliance rebates.
  - Recycling programs including yard waste.
  - Water conservation programs.

Landscaping and Yard Maintenance

Appropriate landscaping can help conserve water, shield and buffer riparian areas, and reduce stream contamination. Similarly, appropriate yard maintenance techniques can reduce stream pollution and contamination. The following proposed solution options address some of the major landscaping and maintenance elements.

- Encourage appropriate landscaping activities.
  - Develop landscaping education programs as an element of the Public Education Plan.
  - Use native species and low water use plants.
  - Reduce chemical application.
  - Recycle yard debris.

  - Increase use of pervious materials on residential lots.
- Encourage citizen protection of riparian areas.
  - Riparian area preservation education would be an element in the Public Education Plan.
  - Encourage volunteering to help clean up riparian areas and planting native vegetation.
  - Encourage stewardship programs.

Vehicle Maintenance

Encouraging proper maintenance techniques will reduce the possibility of contamination entering local streams.

- Include a Vehicle Maintenance Program as part of the Public Education Plan.
  - Encourage households and businesses to use appropriate disposal/recycling of vehicle maintenance fluids and equipment.
  - Encourage use of spill containment for home and business auto repairs.

Household

While there is a lower risk that household cleaning and maintenance activities can impact local streams, encouraging the use of low impact household chemicals can further reduce that risk. The following proposed solution option can become a part of the Public Education Plan.

- Encourage use of "fish friendly" or low impact non-toxic household cleaners/chemicals. Many household chemicals dumped down sewers cannot be effectively treated and are discharged to the Willamette River.

## CONCLUSION

This chapter addresses the process used to develop the proposed solution options. The solution options are the culmination of Phase I, development of the baseline conditions, and Phase II, assessment of city activities and citizen behavior on the existing conditions.

Actual and potential impacts to the existing habitat and water quality conditions have been quantified and ranked. From this process solution options unfettered by any conditions or restrictions have been identified in order to obtain the widest possible number of solutions that could meet the ESA compliance requirements.

Through a rigorous process of review by City staff, the TAC, and the public, the initial solution options were screened and reduced. The final draft set of solution options cover a wide range of activities that meet the ESA Section 4(d) Rule Limit 12 compliance requirements.

## Table 3. Considerations and Solution Options Matrix

| Solution Option | LIMIT 12 CONSIDERATIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value) | Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed. | Protects riparian areas well enough to attain or maintain PFC | Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible. | Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines | Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands. | Adequately preserves permanent & intermittent streams' ability to pass peak flows. | Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer. | Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies. | Ensures demands on water supply can be met without affecting the flows that threatened salmonids need. | Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs. | Complies with all other state & Federal environmental & natural resource laws & permits. |
| **Land Use** | | | | | | | | | | | | |
| Zoning | X | X | X | X | X | X | X | X | X | X | X | X |
| Development Standards | X | X | X | X | X | X | X | X | X | X | X | X |
| **Park & Recreation** | | | | | | | | | | | | |
| Neighborhood Park Planning | X | X | X | X | X | X | X | X | X | X | X | X |
| Open Space & Recreation Service Plan | X | X | X | X | X | X | X | X | X | X | X | X |
| Capital Improvement Plan | X | X | X | X | X | X | X | X | X | X | X | X |

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| Park O&M Manual | | X | X | | | X | | X | X | | X | X |
| Park Inventory | X | X | X | X | X | X | X | X | X | X | X | X |
| Existing Parks | | X | X | | | X | | X | | | X | X |
| Park Construction Retrofit | X | X | X | X | | | | X | X | X | X | X |
| Mini Parks | X | X | X | X | X | X | X | X | X | X | X | X |
| Specific Parks | X | X | X | | | X | | X | X | X | | X |
| Equipment Maintenance | | X | | | | | | | | | | X |
| Organic Debris Disposal | | X | | | | X | | | X | | X | X |

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| **Construction Specifications** | | | | | | | | X | | | | |
| On-site Construction Activities | | X | X | | | X | | | X | | X | X |
| Construction Site Enforcement | | | X | | | X | | | X | | X | X |
| Hazardous Materials | | X | | | | | | | X | | | X |
| Pipe Commissioning | | X | | | | | | | X | | | X |
| Erosion Control Ordinance | | X | X | | X | X | X | | X | | X | X |
| Sustainability | X | X | X | X | X | X | X | X | X | X | X | X |

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| **Transportation** Planning Elements | X | X | X | X | X | X | X | X | X | X | X | X |
| TDM | | | X | X | | X | | | | | X | X |
| Transportation System Plan | X | X | X | X | X | X | X | X | X | X | X | X |
| CIP | X | X | X | X | X | X | X | X | X | | | X |
| Design Specifications | | X | | | | X | | X | X | | | X |
| Routine Rd. Maintenance - ESA Limit 10 | | X | | X | | X | | | X | | X | X |

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| **Stormwater** | | | | | | | | | | | | |
| Planning & CIP | X | X | X | X | X | X | X | X | X | X | X | X |
| Erosion Control Ordinance | | X | X | | X | X | X | | X | | X | X |
| O&M | | X | X | | | X | | X | X | | | X |
| Monitoring | | | | | | | | | | | X | X |
| **Wastewater** | | | | | | | | | | | | |
| Wastewater Treatment | | | | | | | | | | | X | X |
| Facility Oils & Grease Program | | | | | | | | | | | X | X |

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| Wastewater Collection, | X | | | X | | X | | | X | | X | X |
| O&M | | | | | | X | | | X | | X | X |
| Master Plan and CIP | X | X | X | X | X | X | X | X | X | X | X | X |
| Discharge | | | | | | X | | | | | X | X |
| **Water** | | | | | | | | | | | | |
| Water Supply Conservation | | | | | | | | X | | X | X | X |

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| Water Intake | | | | | | | | | | X | X | X |
| Distribution | X | | | X | | X | | | X | X | X | X |
| O&M | | | | | | X | | | X | | X | X |
| **Citizen Behavior**<br>Public Education Involvement | X | X | X | X | X | X | X | X | X | X | | |
| Incentives | | X | X | | | X | | X | | X | | |

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| Pollution Prevention | X | X | X | | X | X | X | X | X | X | X | X |
| Landscaping | | | X | | X | X | X | X | | X | | |
| Household | | X | X | | | | | X | X | X | | X |
| Vehicle Maintenance | | X | X | | | | | | | | | X |
| Riparian Areas | | X | X | | X | X | X | X | X | X | | X |

# CHAPTER 8. MONITORING/REPORTING

## INTRODUCTION

The ESA Section 4(d) Rules require that any application for certification under this section must include a mechanism for monitoring the effectiveness of the program. NOAA Fisheries is explicit in its publication of the ESA Section 4(d) Rules:

''NMFS [NOAA Fisheries] will evaluate on a regular basis the effectiveness of the program in protecting and achieving a level of salmonid productivity and/or habitat function consistent with the conservation of the listed salmonids. If a program does not meet its objectives, NMFS [NOAA Fisheries] will work with the relevant jurisdiction to adjust the program accordingly. If the responsible entity chooses not to adjust the program accordingly, NMFS [NOAA Fisheries] will publish notification in the **Federal Register** and announce that the program will no longer be free from ESA take prohibitions because it does not sufficiently conserve listed salmonids." (Federal Register, July 10, 2000, page 42426)

The monitoring program that is developed for the Salmon Response Plan does the following:

- Measures progress of the implemented activities under the Salmon Response Plan.
- Compares progress to stated goals in the Salmon Response Plan to quantify progress, and depending on degree of progress either,
    - Determines that the implementation activities are meeting goals, or
    - Determines that the implementation activities are not meeting goals.
- Reports implementation activities to NOAA Fisheries.

If monitoring determines that implementation activities are not meeting the Salmon Response Plan goals of protecting Chinook salmon habitat, the monitoring report to NOAA Fisheries must outline the pro-active steps to be taken to modify implementation activities that will bring the plan into alignment with the goals.

Corrections to the implementation activities will incorporate an "adaptive management" approach, which requires the City to modify its Salmon Response Plan as it becomes more knowledgeable of those activities that may or may not meet the plan goals. Directions are provided in the ESA Section 4(d) Rules Guidance Manual, which states that where monitoring indicates the need for program modification the plan should include "a method for using monitoring information to change actions when needed [through an] adaptive management" approach (National Marine Fisheries Service Northwest and Southwest Regions September 22, 2000, page 8).

In addition to the mandatory requirement that the monitoring plan has to fulfill the certification process, it will also function as a practical document that the City will use internally to measure progress. Importantly it will be used by to document for City officials and the public progress toward meeting the plan's goals. In that capacity it will become the official statement on the program's ability to further prevent habitat degradation and to restore PFC. Where plan deviations are identified, it will be used as a tool to outline the pro-active steps to be taken to correct plan deviations in order to keep the plan on track.

**Monitoring Plan Format, Frequency and Content**

NOAA Fisheries does not state monitoring frequency or the report format to be submitted. The ESA Section 4(d) Rule Guidance only requires that the jurisdiction have a plan and "a schedule for conducting monitoring and submitting reports."

The monitoring plan submission should be a formal report to NOAA Fisheries. It should contain only the information necessary to demonstrate how the plan is meeting the main and legal objective of preventing further habitat degradation. It should also demonstrate, as the plan becomes capable of doing so, that it is meeting the secondary objective of putting the City on a trajectory of restoring PFC.

Given the nature of what is to be monitored and the cycle of assessment that will need to be developed, the monitoring program should be conducted on an annual basis for the following reasons:

- Programmatic Monitoring activities
    - Many activities rely on an annual funding and budgeting cycle.
    - Other related activities and programs have annual reporting requirements that can be incorporated into this monitoring plan.
    - Annual monitoring is a useful time period to develop trend lines for annual comparisons.
- Scientific monitoring
    - Much of the scientific monitoring will need to be conducted on an annual basis and some of it even more frequently in order for there to be data collection and measurement consistency.
    - Other related activities have annual data collection and evaluation requirements that can be incorporated into this monitoring plan.
    - Annual monitoring is a useful time period to develop trend lines for annual comparisons.

The monitoring plan described in this chapter has two elements. The first is the programmatic element. Monitoring will evaluate the programs and program implementation outlined in the plan. It will focus on overall program development and implementation that will take place during the life of the plan. Since the plan is a comprehensive, cross departmental effort to prevent further Chinook salmon habitat degradation and restore PFC, there are a complex series of activities to be implemented over the plan's life. The programmatic element will assess both the implementation progress and the efficacy of the programs toward meeting the plan goals.

The second element is the actual scientific monitoring that will rely on the collection and assessment of data from project area streams. These data will address the physical aspects of the Chinook salmon habitat and the changes in habitat conditions over the life of the plan. Like the first element, where data assessment indicates that program activities do not meet the plan goals, the City will need to modify its programs or else risk losing federal government protections.

Though the two elements are somewhat separate, the programmatic and scientific monitoring will be combined into a single report to submit to NOAA Fisheries. The last section of this chapter outlines how results from the programmatic and scientific monitoring will be integrated and presented to NOAA Fisheries. The monitoring plan to be submitted will include the declaration of compliance with ESA Section 4 (d) Rule requirements for continued certification, the monitoring data that demonstrates compliance, and, for those activities that may not be contributing toward the Section 4(d) Rule objectives, corrective steps to be taken.

## PROGRAMMATIC MONITORING

Programmatic monitoring covers all the programs to be implemented to prevent habitat degradation and initiate restoration of PFC. As described in detail in Chapter Seven, the actual suite of program solutions to be implemented across three city departments and several divisions within each department is very complex and requires a well organized monitoring plan. In addition, there are citizen behavior activities to be implemented, which will likely impact in one way or another all the City program activities.

Not all program activities will be implemented simultaneously, nor will each activity be fully mature when initiated. The activities will be implemented over a multi-year period and develop and mature over time.

Activity implementation will be based on several factors including the type of activity to be initiated, funding necessary to finance the activity, ancillary activities that may be necessary to support an activity, and the logistical mechanisms (departmental and political support, staffing, supplies, etc.) that will need to be in place before the activity can be implemented. Consequently the following steps will be taken to monitor these programs.

- Development of a timeline and implementation schedule,
- Identification of activity initiation and subsequent milestone steps to meet the implementation schedule, and
- Identification of goal achievement – ultimate goal(s) and interim goal(s).

**Implementation Timeline and Milestones**

There are approximately 43 activities that the City will implement as part of the plan. Many of them are made up of multiple elements or "sub-activities" that will need to be implemented before the activity is fully effective. With such a large number of activities, the timing of their implementation will be critical. Therefore, the plan will need to include a master schedule that can be used as an activity-initiation checklist.

As mentioned, not all activities will be initiated at once. Activities related to changes or modifications to the City's zoning and land use development code are dependent on other ongoing projects (e.g., Goal 5 project, periodic review, etc.). Similarly, some activities that are related to the implementation of the City's Stormwater Master Plan are scheduled for implementation over several years, and need to be included in a comprehensive timeline.

In other instances, some activities cannot be implemented until another activity is implemented or even completed. For example, the retrofitting of existing City parks to reduce negative impacts to Chinook salmon habitat, if any, cannot take place until the Parks and Recreation Department completes its park inventory.

The timeline elements will include the following:

- 10 year time horizon divided into quarters,
- List of activities to be implemented categorized by department,
- Each activity will list an initiation date and the exact activities or "sub-activities" to be initiated. In many instances there is expected to be multiple dates as a program is initiated or expanded as it matures.
- Ongoing programs will be listed as such and will identify any additional activities to be included in the implementation period, and
- Activities with end dates or sunset dates will be noted.

Associated with the timeline and initiation dates will be a list of expected milestones. Milestones will be defined as those specific achievements that are related to the plan. Only those milestones that are specifically related to the plan will be included. The milestones will be itemized by activity and date they are expected to be met.

### Identified Goals

A set of specific, measurable goals will be identified for each of the activities. These goals are critical because they will be compared to the progress that is documented in the monitoring assessment to determine overall plan progress. While the plan's ultimate goal is to prevent further degradation to Chinook salmon habitat and to secondarily initiate restoration of PFC, it is impossible for an individual activity to achieve that goal alone. It is the sum of the individual activities' goals that will result in the ultimate achievement of the plan. Consequently, it is expected that goals for individual activities will be very specific and likely differ depending on where the activity is in its implementation timeline.

It is important that the goals be measurable. While goals need not be quantitative, they should identify a specific achievement to be reached. For example, the parks inventory and assessment activity has the goal of identifying park design or structures that may have negative impacts on Chinook salmon habitat. Therefore, the measurable goal could be that the inventory will be conducted in phases with a certain number completed by each phase. The goals are specific and easily measurable.

Other goals may be more difficult to measure. Construction site enforcement is a good example of this type of goal. While it may be easy to quantify on-site visits by enforcement officials and the actions that they may take, a goal based on number of site visits and enforcement actions may not be a reasonable measure for compliance. Goals will need to be carefully considered in order to identify measurable goals for use in the monitoring plan.

### Timelines and Goals Matrix

The activity timelines/schedules and goals will be combined to create a master matrix that outlines not only the schedule for implementation and the milestones expected by specific date, but also the goals to be achieved. This master matrix will become the basic tool used to evaluate programmatic progress.

The following steps will be taken annually to monitor programmatic progress:

- Collection of information on the programs that are initiated and the specific activities performed over the previous 12 months,
- Comparison of the activities initiated, and related milestones, to activities expected to be initiated in the master matrix,
- Determination as to whether the goals have been met and, if not, a determination of the degree of progress.

Once the initial monitoring assessment is completed and a determination is made for each program activity there will need to be an overall assessment that addresses what this means. This is important as it can help the City make choices, if needed, regarding how to move forward should program activities not meet their goals.

It could be that the City finds some activity goals are unrealistic or that some activities are more important that others. Again, the ultimate goal is to not further degrade Chinook salmon habitat and that meeting this goal is the sum of all the activities. Therefore, the failure or success of a single activity would not necessarily translate to failure or success of the plan itself. Since it will be the actual scientific measurements (see the next section on the Chinook salmon habitat monitoring program) that will determine whether the plan is successful, it is presumed that implementation of programmatic activities will result in the scientific information showing that the plan's ultimate goals are met. Whether all activities must all be meeting their goals at all times is open to interpretation.

From a literal interpretation, a program that does not meet its goals is technically in need of corrective action. Steps to be taken to correct the activity direction would need to be identified and a timeline developed that would put the activity back on schedule. This should be done for the monitoring report.

From the practical standpoint, it may be that certain programs are more important than others and that if these do not meet their goals, the City, with limited resources, may decide to focus on the most important activities first. The approach to activities and their differential impact will be addressed in the last section of this chapter.

### Programmatic Reporting

From the standpoint of the monitoring program and reporting, all activities will need to be evaluated equally in order to assess the progress of an activity from year to year. Once the activities are assessed and a determination is made as to whether an activity has met its goals, the programmatic portion of the monitoring report can be prepared.

The programmatic report will include the following sections:

- Matrix showing, for the year in question, the schedule of activities to be initiated or performed, their milestones and expected goals,
- The actual assessment of what each program has accomplished,
- The comparison between goals and actual accomplishment, and
- Corrective steps and a schedule to bring activities that do not meet their goals back into line.

## CHINOOK SALMON HABITAT MONITORING PROGRAM

### Objectives

Stream monitoring generally results from questions concerning the impact of land cover and land use activities on water quality and system health, and the desire to predict outcomes from any changes. These may involve increases in runoff through changes in vegetation cover type, or increases in impervious surfaces altering sedimentation patterns, sediment fluxes, and chemical inputs to the streams. Other human activities causing changes in stream health include flow removal and alteration for drinking water, irrigation, and hydroelectric power generation. The monitoring objective, type of problem (for example, nutrients versus toxic metals), and use of information (for example, a local management question versus legal litigation) determines the necessary stage of analysis. As part of its Salmon Response Plan, the City must develop a monitoring plan to assess the impact of any activities by the City to ensure compliance with the ESA, as well as the outcomes of any rehabilitative projects undertaken.

The stream habitat baseline assessment completed as part of Phase 1 of the ESA 4(d) Program forms a critical element of the monitoring effort for the City. The stream reaches identified in the Corvallis ESA 4(d) Assessment Phase 1 Report contain the monitoring points. This project identified representative sampling transects and collected baseline data using the methodologies described by United States Forest Service (USFS) Level 2 Stream Habitat Analysis, USFS Guidelines for Establishing Stream Reaches, and the Oregon Department of Fish and Wildlife (ODFW) Stream Habitat criteria.

The ESA habitat assessment sampling established GPS-monumented transects with the reaches to facilitate return to the same locations for monitoring. The study measured five cross sections, using channel width and depth at 0.5 m intervals, for each reach. In addition, the study identified existing instream habitat types within each reach, measured erosion, substrate type, percent cover, amount of overhang, and shading. As well, the City placed 12 thermistors (temperature gauges) in selected locations in each of the urban stream systems in the summer of 2001. These gauges provide an hourly record of temperatures at each location (see Figure 4 and Tables 4 and 5 for map and locations of GPS transects and thermistosr).

This initial baseline assessment, in combination with the City's current temperature and water quality sampling, measures most of the necessary parameters, paying close attention in the study design to the seasonality and natural variability inherent in each variable. The pathways analysis established the parameters of interest for monitoring purposes. These consist of channelization, instream habitat, impervious surface, riparian areas (buffers), and barriers to fish movement.

## Figure 4. GPS Transects and Thermistor Locations

*See separate file*

**Table 4. GPS Transect Locations**

| Identification Label | Down Steam Point | | Up Stream Point | |
|---|---|---|---|---|
| | Latitude | Longitude | Latitude | Longitude |
| DuCSFR1 T1 | 44.54818 | 123.29968 | 44.54794 | 123.30085 |
| DuCSFR2 T1 | 44.55043 | 123.30997 | 44.55100 | 123.31099 |
| DuCSFR3 T1 | 44.55142 | 123.31224 | 44.55136 | 123.31364 |
| DuCR1 T1 | 44.55280 | 123.27928 | 44.55222 | 123.27976 |
| DuCR2 T1 | 44.55038 | 123.28030 | 44.54988 | 123.28134 |
| DuCR3 T1 | 44.54925 | 123.28489 | 44.54898 | 123.28510 |
| DuCR4 T1 | 44.54974 | 123.28983 | 44.55005 | 123.29097 |
| DuCNFR1 T1 | 44.55395 | 123.29337 | 44.55405 | 123.29468 |
| DuCNFR2 T1 | 44.55692 | 123.30031 | 44.55751 | 123.30089 |
| OCR1 T1 | 44.55492 | 123.27821 | 44.55498 | 123.27925 |
| OCR2 T1 | 44.55646 | 123.28096 | 44.55688 | 123.28194 |
| OCR2 T2- | 44.55927 | 123.289457 | 44.560187 | 123.289517 |
| OCR3 T1 | 44.56591 | 123.299571 | 44.566511 | 123.30062 |
| OCR3 T2- | 44.57072 | 123.30914 | 44.57104 | 123.31030 |
| OCR4 T1 | 44.57135 | 123.31230 | 44.57137 | 123.31349 |
| OCR4 T2 | 44.57612 | 123.32648 | 44.57682 | 123.32731 |
| OCNTR1 T1 | 44.57192 | 123.31089 | 44.572809 | 123.31066 |
| OCNTR2 T1 | 44.58653 | 123.30796 | 44.58730 | 123.30815 |
| OCNTWF T1 | 44.58100 | 123.30867 | 44.58936 | 123.30940 |
| OCNTR3 T1 | 44.59001 | 123.308309 | 44.59078 | 123.30914 |
| DCR1 T1 | 44.57472 | 123.25347 | 44.57471 | 123.25452 |
| DCR2 T1 | 44.57346 | 123.26357 | 44.57424 | 123.26379 |
| DCR2 T2 | 44.57662 | 123.26826 | 44.577255 | 123.26912 |
| DCR3 T1 | 44.58522 | 123.27454 | 44.58532 | 123.27580 |
| DCR4 T1 | 44.58957 | 123.28201 | 44.59021 | 123.282641 |
| DCWF T1 | 44.59188 | 123.29665 | 44.59236 | 123.29767 |
| DCWF T2 | 44.59597 | 123.30370 | 44.59656 | 123.30409` |
| DCMF T1 | 44.59340 | 123.28559 | 44.59359 | 123.28667 |
| DCMF T2 | 44.59613 | 123.29050 | 44.59685 | 123.29097 |

**Table 4. GPS Transect Locations**

| Identification Label | Down Steam Point | | Up Stream Point | |
|---|---|---|---|---|
| | Latitude | Longitude | Latitude | Longitude |
| DCEF T1 | 44.59328 | 123.28406 | 44.59398 | 123.28463 |
| DCEF T2 | 44.59481 | 123.28507 | 44.59566 | 123.28526 |

**Table 5. Thermistor Locations**

| Identification Label | Thermistor # | Latitude | Longitude |
|---|---|---|---|
| SQC13 | 5508 | 44.54796 | 123.30050 |
| SQC14 | 5507 | 44.55282 | 132.27977 |
| OC7 | 5506 | 44.57646 | 123.32702 |
| OC8 | 5504 | 44.57141 | 123.31193 |
| OC9 | 5503 | 44.57141 | 123.31193 |
| OC10 | 5505 | 44.57137 | 123.31071 |
| OC11 | 5502 | 44.55664 | 123.28180 |
| OC12 | 5501 | 44.55495 | 123.27918 |
| DC3 | 5500 | 44.59191 | 123.29693 |
| DC4 | 5498 | 44.59350 | 123.28587 |
| DC5 | 5499 | 44.57806 | 123.26986 |
| DC6 | 5497 | 44.57472 | 123.25335 |
| SEC1 | 4296 | 44.60041 | 123.26248 |
| SEC2 | 4292 | 44.59020 | 123.24506 |

Monitoring of changes in the riparian buffer will use both the existing ESA project data and the NFI riparian species identifications. Unfortunately, the lack of any quantitative survey work precludes use of most of the NFI database. The baseline analysis, when combined with those elements of the NFI project, allows the prediction of the trajectory of current habitat effects succession as changes occur. Determination of succession uses analysis of historic changes and current conditions to predict the future. This facilitates determining the fate of the various habitat elements, as well as developing correlations between natural and anthropogenic conditions and habitat effects.

Monitoring variables of interest include flow, stream geomorphology, high flow turbidity, nutrients (nitrogen, phosphorous), pesticides (including insecticides and herbicides), industrial chemicals, and heavy metals. This focuses chiefly on the contamination and habitat pathways. There exists sufficient background knowledge of these parameters to formulate correlations with existing land cover/land use (LC/LU) patterns, and to predict the expected direction and magnitude of changes. The plan need not measure dissolved oxygen or any biotic parameters, unless nutrient measurements increase during the low flow season, indicating potential for anoxic conditions. The plan should have a structured sampling periodicity to fit both the proposed changes in LC/LU activities and the periodicity expected from each of the water quality variables.

The overall goal for monitoring consists of shifting the above-mentioned parameters toward PFC when possible, or allowing no further degradation. PFC refers to the retention of the underlying habitat-forming processes while changing the inputs to achieve a system functioning in a manner beneficial to fish. Urban systems present the greatest challenge to obtaining PFC, as they contain a great deal more "constraints", which restrict rehabilitative actions.

**Monitoring Study Design and Approach**

Monitoring of stream ecosystems to determine if some impact has significantly altered the integrity of the stream or site in question requires the determination of the appropriate scale of inference. For example, to describe the physical and biotic components within the ecoregion, sample sites should represent the types of streams occurring within that spatial scale. Selecting sampling locations involves two different processes. First, is the selection of sampling reaches. This involves selecting reaches that are representative of the spatial scale of inference and that conform to the statistical design. Second, is the choice of sample site locations within the reach. Sample locations depend on the statistical design and the particular factor to be measured.

The balance of this chapter is divided into two sections. The first section addresses the important scientific concepts that form the basis of the ESA Section 4(d) Rules monitoring study. It covers the methodological underpinnings of monitoring, sampling procedures, periodicity, time series and multiple sites, and water quality analysis. The section concludes with a brief discussion of monitoring design and interpretation of monitoring data that are collected. Without a properly designed monitoring plan, it is possible to introduce interpretation error.

The second section describes the monitoring plan to be implemented. It identifies the data to be collected, the evaluation procedures to be performed and the comparative process that is designed to determine effectiveness of the ESA Section 4(d) Rule plan.

**Classification Methodology and Background**

Stream classification provides a means of stratifying streams and identifying sampling locations that addresses the spatial scale of inference and objectives of the monitoring program. A spatially nested hierarchical framework for classifying stream systems allows managers to identify the spatial scale of inference (Frissell et al. 1986; Hawkins and others 1993; Maxwell et al.1994). In a hierarchical system, lower levels are modified and constrained by factors operating at higher levels. Therefore, an attempt to focus on factors influencing stream ecosystems on a small scale requires awareness of factors operating at larger scales. One cannot evaluate and manage to alleviate the effects of riparian removal when similar or other impacts occur throughout the watershed. The methodologies below provide both the theoretical and technical underpinnings for this understanding.

*Watershed Scale*

The ecoregion exists as the upper level of the hierarchy. Successively lower levels consist of streams, stream segments, reaches, pool/riffle complexes, and microhabitats. Each hierarchical level permits refinement for more precise classification. Inclusion of flow regime further refines the biogeoclimatic aspects and relates to flow, a major environmental driver of stream/riparian ecosystems. Corvallis lies within the Willamette Valley ecoregion, characterized by generally mild climatic conditions, with streams having seasonal flows consisting primarily of rainfall runoff.

Classification requires distinguishing between "regional" versus "local" for climate, geology, and terrestrial vegetation. Proper classification at the watershed level uses the availability of long-term records of atmospheric temperature, precipitation, and stream discharge to develop the information base for these contrasts. Incorporation of thermal regime permits stratification by catchment-level differences. Catchments similar in external or regional biogeoclimatic controls often differ in their thermal environments because of different make-up combinations of ground and surface water or different aspect of orientation to the sun.

The following discussions place the Corvallis area in its appropriate regional context. Foothills dominate the northern and western parts of the city separated by smaller stream corridors and valleys, flowing east to the Willamette and Mary's Rivers. The hills have moderate to steep side slopes (10 to 25 percent). Floodplains and terraces rise stepwise from the Willamette and Mary's Rivers towards the Corvallis foothills.

The Willamette and Mary's Rivers create the two major hydrologic basins within the study area. Dunawi and Oak Creek, both tributaries of the Mary's River, drain the western part of the city. Other small, perennial streams discharge to the Willamette River, (Dixon Creek, Jackson Creek, Frazier Creek, Lower Booneville Channel, Sequoia Creek, Stewart Slough and their tributaries).

Upland soils mainly comprise moderately deep, well-drained silty clay loams and shallow, well-drained silty clays, with minor amounts of clay loam, clay, and silty-clay. Association on the slopes and upper terraces developed on mixed alluvium from glacial outbreak floods in well-drained locations and contain moderately well-drained and well-drained silt loams. A series of poorly drained clays dominate in the lowland areas, preventing significant infiltration of rainwater.

*Stream Classification*

The lower spatial scales depend upon analyses performed at the reach- and point-scales, and require classification of the segments in order to establish correlations suitable for statistical evaluation. As well, the classification methodologies, particularly Rosgen's approach, provide an excellent diagnostic basis for assessing stream changes, or in combination with other techniques (Montgomery-Buffington 1993) provide a quantitative approach for assessing the likelihood of rehabilitation project success.

Classification of stream segments uses conventional geomorphology practices based on either tributary junctions, or major geologic discontinuities or both. Rosgen (1996) provides criteria for distinguishing stream reach classes. Important habitat-forming processes at the stream reach level include sediment budgets (substrate type) and large woody debris (LWD).

Valley and channel features (Rosgen 1996) further characterize the physical environment. Channel slope (gradient) influences current velocity, turbulence, and substratum composition. Valley form uses the degree of entrenchment; the ratio of flood prone width divided by bankfull width. Bed form indicates whether the channel is straight, braided, or meandering. Sinuosity, the ratio of channel length to valley length, indicates the extent of meandering by the stream. Width/depth ratio, width at bankfull stage divided by bankfull depth, measures the distribution of energy within channels. The use of valley form (Rosgen 1996) in place of side-slope gradient better characterizes features important to riparian as well as stream dynamics at this classification level. Classification of pool/riffle systems provides important descriptions of the desired fish habitat features.

**Sampling Design**

Effective outcome-based monitoring of a project or process requires the establishment of cause-effect correlations between actions and results. This makes the use of statistics to establish a quantitative basis critical. The use of "best professional judgment" especially needs the support of a quantitative sampling program and the resulting correlations, even if it fulfills the regulatory agency requirements. Developing this sampling program requires knowledge of sampling frequency at different temporal scales. For instance, larger scales deal with the scale of inference determined by the sampling objectives and the spatial level of disturbance or interest. The smaller temporal scales address the sampling frequency necessary to adequately characterize the factor measured. This depends on the factor and stage of analysis.

Natural landscape disturbances of a given frequency generally occur at a particular spatial scale; the longer the recurrence interval of a disturbance, the larger the spatial scale, and the higher the system organizational level of the system (O'Neill et al. 1986). For example, in the Pacific Northwest small forest fires occur frequently but over small areas. Fires occurring over larger areas have much longer recurrence intervals. The relationship between natural spatial and temporal scales of disturbance helps determine sampling frequency.

*Corvallis Stream Habitat Sampling*

Sampling to obtain background or reference data uses the scale of inference (spatial scale) to establish sampling frequency. For example, at the ecoregion scale of inference with sites stratified by stream order, sampling should occur annually at first-order sites, every other year at third-order sites, and every five years at sites greater than fifth order. Small order sites drain a smaller area than large-order sites. Therefore, stream conditions likely will vary on a shorter temporal scale and require more frequent sampling to document natural variability.

The temporal scale of the Corvallis ESA monitoring effort should continue to measure and replicate stream physical habitat and cross sections yearly to determine the changes associated with conditions in the stream. The interpretation of these data requires caution, however, as even in a system not influenced by human activities, these parameters change through time. The cross-sections should change gradually, as part of the stream's evolution. Any dramatic changes in the lower reaches over a 5-year time span indicates both a lack of stream equilibrium and the continued presence of inputs that caused the shift away from "typical" stream evolution. These include inputs of stormwater runoff such that the streams continue to downcut. If these inputs decrease, the City should expect a gradual decrease in depth as the stream adjusts its sediment deposition accordingly.

The reaches high in the system will likely show changes in stream cross-section, as the incision progresses more quickly initially as the result of continued increases in overland transport of stormwater runoff and the presence of relatively easily-eroded soils in proximity to and within the stream channels. The baseline study considered this when planning the sampling design and placed cross-sections in areas expected to show changes quickly in respect to changes in corresponding land use. The rate of change, rather than the amount of change, will provide more information on the effects of any City-initiated changes in land use or operations.

*Site Selection for Evaluation of Point and Non-Point Actions*

Monitoring to determine possible impacts usually involves comparing impacted sites with reference sites. Reference sites replace the more rigorously defined "controls" of a laboratory experiment and create many problems associated with the validity of comparisons. Reference sites generally consist of either a similar location upstream of the disturbance (for small-scale impacts), the same location prior to disturbance, or a similar site or sites located on a different stream or streams (either historic or contemporary data). The selection of impact and control sites varies with the spatial scale of the disturbance. If the disturbance affects an entire basin, comparisons would use historic data (same location or different location within the ecoregion) or data from other streams in similar basins.

Effective management of local ecosystems (for example, stream reaches or watersheds) requires attention to the landscape in which they occur. In general, the City should confine any reach comparisons to within-watershed. Should cross-watershed comparisons prove necessary, the City should restrict them to reaches with similar gradient and longitudinal stream position. The City should use similar criteria for establishing monitoring of changes in instream habitat type as it, too, evolves with the stream geomorphology.

The following example outlines the dangers inherent in sample site selection and spatial scales. The same cautions hold true for temporal scales. Assume the random selection of sample sites from any sized stream (first to fourth order), and any segment of these streams (confined high slope to unconfined shallow slope). Despite the high degree of variability in these data, this sampling design provides a means to distinguish differences among ecoregions, while not allowing the comparison of differences among locations within the ecoregion. Sample sites located on steep-sloped first order streams cannot provide data representative of all streams within the ecoregion nor does it allow comparisons of stream reaches contained within different kinds of stream segments, systems, or ecoregions. One would not compare physical data obtained from a large river with similar data from a small headwater stream.

No matter what spatial scale of disturbance, reference sites should have as similar a classification to impacted sites as possible, not necessarily proximity to impacted sites. Proper and similar classification of impact and reference reaches ensures viable comparisons. Decisions concerning sample site location depend on the study design and the nature of any statistical comparisons. Comparative data require the selection of a sampling location that provides the best measurement of the parameter. For statistical comparisons all suitable locations within the reach should have an equal probability for being selected as sampling sites.

The relationship between spatial and temporal scales also facilitates impact evaluation. For example, climate operates at the spatial scale of a watershed or ecoregion. Impacts at this spatial scale (depending on intensity) influencing stream systems at a temporal scale from 10 to 100 years necessitate monitoring every few years rather than monthly. However, citywide operations warrant an annual monitoring regime with monthly sampling during the summer months to evaluate such outcomes as influence of facility practices on water quality.

Selection of the appropriate temporal scale of operation facilitates the selection of the optimal sampling frequency to characterize the variability in stream structure and function. Any differences observed between treatment and control sites may suggest the presence of suspected problems, but only sampling for multiple years or comparison to long-term sampling locations can confirm that the differences represent changes outside the normal condition.

The frequency of sampling depends on the parameter and the stage of analysis. The characterization of the variability of same parameters of interest requires only annual sampling (e.g. large woody debris and substratum size distribution) as they result from processes occurring at a longer time scale (bankfull or 2-year flooding). As bankfull flows generally occur during annual rainfall periods for Corvallis streams, more frequent measurements of these parameters prove unnecessary. Most of the parameters measured vary throughout the year and sampling frequency increases with the stage of analysis to better characterize these changes.

**Statistical Design**

A monitoring program usually attempts to determine differences between treatment and reference sites, or correlations (cause-effect) between variables of interest and activities. Determining this successfully depends on the action under investigation and often requires statistical comparisons. All the variables of interest rarely get collected, making the taking of a sample necessary. Sampling obtains a portion of the total population to use to make inferences about the total. Statisticians refer to the characteristics of the total populations as parameters, and an estimate of a parameter obtained from a sample as a statistic. For example, a statistic will include such calculations as the arithmetic mean obtained from the samples used to estimate the population mean. The more samples obtained, the more resemblance of the sample statistics to the population parameters.

If no need to sample existed (i.e., the observer has access to the entire population) simple parameter comparisons could determine any differences. However, as the analysis compares samples of the population, statistical analyses determine the probability of the samples from the reference and impacted sites representing the same population. The observer formally states this as a null hypothesis: no difference exists between impacted and reference sites. This statistical inference contains within it the possibility of committing two types of error. First, one could conclude that the samples come from different populations when in fact they do not. This represents a Type I error. Second, one could conclude that the samples come from the same population when they do not. This represents a Type II error. The problem lies in that by attempting to reduce one type of error, the other type increases. Since increasing the number of samples causes sample statistics to approach population parameters, increasing sample size helps reduce the probability of committing Type II errors.

Increasing the number of samples increases sampling and processing time and associated costs. Therefore, in selecting the number of samples taken, one attempts to increase confidence in statistical analysis while reducing time and costs. The exact number of samples required to obtain a certain level of confidence in the statistical analysis depends upon on the magnitude of difference in populations determined as significant by the observer, and the variability among samples. Bio-ethicists suggest that observers prefer the potential of a Type I error in cases involving only expense, and a Type II error in those cases containing risk to humans or animals of interest.

Statistical analytical procedures use parametric or nonparametric methods, each depending upon different assumptions and the underlying distributions of the variables in question. Parametric tests require meeting the following assumptions: random sampling from a normal population and equal variances. Data transformation can resolve problems associated with non-normal distribution and inequality of variance, but failure to meet these assumptions requires the use of nonparametric alternatives.

Sampling programs should measure chosen parameters at intervals of time and space reflecting the variability inherent in the system. The value in choosing somewhat conservative parameters lies in the ability to effectively capture their variability within the sampling program without prohibitive expenditures. However, the analytical process should effectively remove the background "noise" (e.g. natural variability associated with ecoregion-level processes) from the data through use of the existing background data sets. This allows the assessing and correlating of the "residuals" with associated watershed controls and processes, and the establishing of cause-effect relationships.

*Single Site or Time Period Analyses*

Assessing the difference between reference and impacted sites compares only two statistical populations: factors at reference sites and those at the treatment sites. Appropriate statistical tests for these comparisons include parametric t-tests or analysis of variance (ANOVA). Nonparametric tests include alternatives for continuous data, and chi-square tests for discrete data. The nature of some of the parameters of interest in monitoring allows for only qualitative comparisons. Data variation problems arise when comparing single- and two-sample sites. The variation determined by these small samples renders any inference concerning differences essentially impossible. Observers should conduct replicated sampling at each site to allow meaningful comparisons.

Multiple reference and treatment sites still represent only two populations: impacted and reference. However, variance in this case comes from a number of different replicate streams (or reaches) and should be treated with extreme skepticism despite similar classifications. Many of the factors measured vary considerably among differently classified stream reaches. For example small upland confined streams contain larger particles than larger floodplain streams. This inherent variability masks impact effects, increasing the chance of committing Type II errors.

Impacts occurring at discrete locations allow the use of a paired t-test as the statistical design (assuming assumptions are met). For example, multiple sites may potentially face impacts resulting from the presence of road crossings. Impacted sites below the crossing and reference sites above get paired, with the sampling statistic as the difference in factors between these two sites at multiple locations. This reduces the stream variability and reduces the probability of committing a Type II error.

Any monitoring of reach-scale restoration activities designed to improve contaminant levels will likely involve the following study design: an "upstream-downstream" model testing the hypothesis that any detected changes in the baseline result from a specific action or activity and attempts to obtain statistical correlations between or among actions and observed outcomes. Many point- and non-point-source monitoring programs use approaches that statistically evaluate change by examining differences in parameter means. These generally consist of data time-series analyzed using moving averages calculated over some time (typically seven days) of maximum or mean temperatures, measured upstream and downstream of a designated point-source or area of concern.

This upstream-downstream design presents severe statistical problems, especially in the assumptions used in the comparison of sites and determining the presence of significant changes in parameters as the result of some action. A more appropriate design than the simple paired before-after analysis uses Before-After-Control-Impact Paired Studies, which has a similar design, but rather than compare means from each data set, instead compares the variability in a time-series from each site. This allows the use of the same parametric or non-parametric statistical analysis procedures, but more appropriately reflects differences as the result of the "treatment" rather than pre-existing differences in variable concentrations.

*Multiple Site or Time Series Data*

Multiple years of data from both locations creates a study design analogous to multiple reference and impacted sites. In this case data variability comes from the same stream over time. Sampling during the same time interval, allows comparison of each year individually; beneficial for short-duration impacts or monitoring of management.

The presence of the time series of temperature data provides a useful baseline for the analysis of the influence of future land use changes on watershed health. Time series analysis applies a basic regression model to data collected between discrete times. This methodology uses the order of the observations to assess the past and future behavior of the variable(s). This provides some degree of both prediction of future behavior, and correlation with past events, occurring within the time series. Taking advantage of this predictive capability requires understanding the processes within the system, and estimating its parameters.

Time series regression allows the observer to use the data collection series to directly correlate the endogenous (dependent) variable, with the associated exogenous (independent) variables, or to "lag" the endogenous with the exogenous. The latter methodology uses dependence upon the past values of the latter to predict the current values of the former. For example, it may prove desirable to examine the influence of various factors on temperature. Exogenous variables include shade, groundwater, and the temperature of the upstream flows past a designated point. The upstream temperatures represent an exogenous variable that requires "lagging" to fully develop the correlation.

Further time series analysis models include “unreplicated” (before-after with a single intervention), paired designs (following the BACIPS model), and ARIMA models. ARIMA stands for auto-regressive integrated moving average. These represent the great majority of time series models found in the literature, especially intervention models. Intervention models examine the time series for responses to events. Detailed explanations of these methodologies go beyond the scope of this report, however, the statistical analytical procedures exist on most “canned” packages, and most advanced statistics texts contain detailed descriptions of the available models.

As an example, the nonparametric analytical procedure, the Seasonal-Kendall trend analysis available in the WQHydro statistical software package, requires a minimum of thirty data points to detect the presence of statistically significant trends at any given monitoring site. For each site, the data set gets divided into twelve subsets, one for each month, with the analysis of each of these subsets for the direction, magnitude, and significance of trends. The test compares these subsets and generates an annualized result, indicating the existence of any significant trend, and its magnitude and significance. This procedure also ensures the consistency of increasing or decreasing trends through time, and the separation of actual trends from normal seasonal variation.

Another non-parametric methodology, superposed epoch analysis, provides a useful methodology for examining the behavior of selected variables under changing controls, such as climate or geologic phenomena. The methodology requires simultaneous collection of biotic or physical parameter data and simultaneous information on the control variable(s) of choice. The analytical procedure uses a non-parametric ranking methodology, such as Spearman’s rank, to organize the data of interest. This methodology provides a suitable approach to data analysis at the landscape or similar such hierarchical level. This provides, perhaps, more statistical power than necessary for the project, although some utility may lie in analyzing the outcomes of larger time scales.

Multivariate analyses also apply in some situations. Treatment sites often vary in intensity and treatments vary directly or over time. Parametric analysis of variance (ANOVA) or a nonparametric alternative (Kruskal-Wallis) could determine the effectiveness of a management action, with each year representing a separate factor. Likewise, correlation between stream condition and years since the action could also evaluate management actions. In this case, treatment intensity changes with time.

**Corvallis Water Quality Monitoring**

Water quality sampling for the monitoring program should begin with the first significant rainfall and continue during the next several storms, in order to assess the timing and amount of inputs to the stream systems. Sampling should also include the summer low-water period to assess residence time of various compounds.

The United States Geological Survey (USGS) North American Water Quality Assessment (NAWQA) program used Dixon Creek as one of its study streams. The chemicals found in it placed it in the non-agricultural category. These included Carbaryl (Sevin), used for both home and landscape applications; Dichlobenil (Casoron) and Tebuthiuron, used to control broadleaf weeds, and under asphalt and railway rights-of-way (ROW); Diazinon, uses similar to Carbaryl; and Prometon, used in urban landscaping, ROW, and industrial applications, and by homeowners. Dixon Creek also exceeded standards for temperature, fecal coliform, and *E. coli* bacteria. It appeared to have no excessive nutrients.

Dixon Creek likely carries the "usual" urban runoff components of metals, other organic compounds, and petroleum products. Indeed, a study done for the City of Salem by the USGS found excessive levels of lead, zinc, DDD, DDE, DDT, and several polycyclic hydrocarbons. This data set should provide Corvallis with guidance as to what to expect in its urban streams. As a result, good data on most of the water quality parameters already exists and should function extremely well as the baseline for assessing the impact of City actions and its citizen's behaviors on the streams of the area.

Oak Creek, as the result of the agricultural land uses on the middle reaches, may require a baseline more skewed toward nutrient levels. Dr. Stan Gregory of Oregon State University (OSU) has initiated a $N^{15}$ study in Oak Creek that should prove very useful. Despite a long-term focus on the problem of herbicide transport in surface runoff from agricultural application, until recently little detailed investigation of the transport of herbicides in surface runoff from roadside applications exists in the literature. Because of the NAWQA program, the USGS measured the concentrations of urban, rural, and forest chemicals in select water bodies across the country.

The water quality variables measured by the NAWQA program, and the others mentioned earlier should comprise the extent of the City's water quality assessment. See Appendix 10 for a discussion of the nature of these parameters and their expected spatial and temporal variability.

*Models for Sample Design and Data Interpretation – Contamination Transport*

Most of the basic theory of herbicide entrainment and transport in runoff information and models apply directly to the other applications, despite its major development in an agricultural context, particularly those related to the time periods following application (rainfall timing, intensity, and duration, and total runoff volume/pounds). The first significant runoff nearly always removes the greatest amount of compound. An often almost exponential decline in the total amount of the compound removed, as well as the runoff concentration with subsequent events, follows this initial rainfall event.

The availability of a compound for transport usually declines with time, even in the absence of precipitation, through

1. A decrease in the total amount of compound stored in the surface layer of the soil (degradation),

2. A decrease in the readily mobilized fraction through slow, progressive adsorption onto the soil matrix, and/or

3. A migration to more strongly binding adsorption sites. A longer lag time between compound application and the first runoff event decreases the amount of the compound removed by that event.

*Cautions – Temperature Data*

The City should also take care in the analysis of temperature data, as the recent literature on stream temperature demonstrates that measurements taken in a reach represent the outcomes from actions or conditions just upstream. Any monitoring of reach-scale restoration activities designed to reduce temperatures should first have the analysis of the baseline completed so as to characterize the parameter's variability, then monitor downstream of the activity. Any comparisons made among and between months at any or all sites should consider this.

**Conclusion**

In conclusion, a plan for ESA outcomes should establish the spatial and temporal scale(s) of interest for monitoring using the approaches described above. The study design should specifically establish sampling sites for the collection of nutrient and other water chemistry data on a temporal scale that would allow correlations with point and non-point sources at each level of interest, similar to the suggestions discussed in the chapters on each and the information on variability of each potential parameter in Appendix 10. The City's sampling program for water quality should allow the development of statistically defensible correlations between LC/LU changes and variations in the parameters of interest using the statistical approaches described above. Numbers of samples taken should reflect the hypothesized variability of the parameter in question, to establish background variability. This permits the testing of the hypothesized cause-effect relationships and a determination of their strength.

## COMBINING PROGRAMMATIC AND SCIENTIFIC MONITORING

Both the programmatic and scientific reports will be integrated before forwarding to NOAA Fisheries. While the monitoring activities will be done separately, they will needed to be combined in order to make a declaration to NOAA Fisheries as to whether the plan is meeting the ultimate goal of no further degradation and restoration of PFC.

As noted earlier, the final determination as to the success of the plan will be based on the scientific information that is collected. If for some reason all the programmatic activities are failing to meet their goals yet the scientific monitoring indicates that there is no further degradation, the City could conceivably declare they are in compliance with the 4(d) Rules. The contrary, however, cannot happen. Scientific monitoring that shows further habitat degradation no matter the programmatic activity success will result in a declaration of non-compliance.

It is doubtful that either scenario could happen, though, because programs have been put into place that, when implemented, will meet the ultimate plan goals as reflected in the scientific monitoring. So, the monitoring plan must be integrated to demonstrate that the City is making progress toward the ultimate goal as reflected by the scientific monitoring and that the activities implemented meet the considerations listed under the ESA Section 4(d) Rules Limit 12 (Municipal, Residential, Commercial and Industrial Program development).

The final report will have the following contents:

- Programmatic monitoring section with the schedule and milestones for the monitoring year, measurement of actual progress for each activity, comparison between the expected and actual progress, determination of corrective actions, if any, and actual corrective action plan.
- Scientific monitoring will outline the factors and the measurements that will be necessary to be maintained for compliance, the actual data collected for each of the factors, the comparison between actual and expected, determination of corrective actions, if necessary, and actual corrective action plan.
- Declaration of whether the plan is meeting the ultimate and secondary plan goals.

The declaration is the most important section in the monitoring report because it is an overall statement of the ability of the City to meet the plan goals. Does failure to show that all scientific factors meet the required measurements mean that the program is out of compliance? How many factors must fail before the program is out of compliance? What about temporal changes, where some factors maybe out of compliance one year and another set the next? The point of these questions is to raise the issue that the monitoring program will have an interpretive component. That some scientific factors do not meet standards that prevent further habitat degradation might be acceptable in the short run if the program activities that influence the scientific factors do prevent habitat degradation in the long run.

It will be critical in the monitoring report to explain why project activities or scientific factors do not comply with the monitoring goals. That failure of a program to meet the goals is not a failure of the program itself. For instance, it could be that a program activity, such as a stream restoration, may have a long-run benefit to salmon habitat, but that it will take some time for those benefits to be seen in the monitoring plan.  While the program activity is maturing, there may be a period when scientific factors do not meet the goals.

Therefore, the declaration section will carefully explain those programs that may have interim goals that could violate the monitoring goals, but in the long run will meet those goals.  There will, of course, be programs that may not meet their goals and will need corrective action.  For these activities the monitoring plan will describe the steps to be taken to put them back on schedule.

# CHAPTER 9. PUBLIC INVOLVEMENT

## INTRODUCTION

Public involvement, participation and information have been an important element throughout the Corvallis ESA Salmon Response Plan project. Not only is it required under the ESA, but the City also has a strong commitment to and history of encouraging public involvement and education. This is reflected in Corvallis residents' and business owners' active participation in the many public opportunities (e.g., public meeting attendance, volunteering on various organization boards and committees, participating on advisory boards, etc.) to provide input on important City projects such as the ESA Salmon Response Plan project. The result is a City whose residents and business owners care about their community and its future, and demonstrate their commitment through active support.

The structure of the public involvement program for this project follows ESA requirements. Public input has been recognized as critical to the plan's success since the public will need to support or "buy-in" to the plan's implementation programs. As a consequence the professional consulting team included a public involvement/education specialist to craft the public involvement plan (PIP) and guide and facilitate the public involvement activities in order to maximize the input opportunities that the public would have.

What follows is a description of the public involvement/education program developed for the ESA Salmon Response Plan project. It describes the various techniques and activities implemented throughout the project.

## PUBLIC INVOLVMENT PLAN

### Plan Structure and Objectives

A professional consulting firm, Cogan Owens Cogan, LLC, was hired to develop and guide the public involvement program (PIP). One of their first activities was to develop a PIP that outlined the overall public involvement objectives, strategies, and specific activities that would be implemented during the project. The PIP recognized Corvallis' unique qualities and stated that the public involvement strategy would have to be multi-faceted since "no single public involvement strategy will be effective in helping the City achieve its desired result", which was broad public support for the response plan effort.

The PIP recognized that public involvement and education would be a key element in the success of the project. The PIP stated, "Not only must the plan have a sound scientific basis for decision making, but the public also must be supportive of the programs to prevent salmon habitat degradation in Corvallis." Building on the requirements of the ESA and the City's historical support for public input, the public involvement strategy provided an outline of activities to educate, involve, inform, and seek contribution from the public throughout the project.

The PIP outlined a program with a variety of techniques to accomplish the City's objectives (see overall PIP and Second Phase PIP in Appendices 11 and 12). The PIP elements included educational activities such as fact sheets (see Appendix 13) and a project-related website. There was a two-way communication structure that included a series of public meetings/open houses, distribution of questionnaires and comment forms (see Appendices 14 and 15), and an e-mailing list. There also was a concerted effort to identify "hot button" issues early in the project through a series of stakeholders meetings and presentations to community groups such as the Corvallis Chamber of Commerce, large land owners (agricultural land owners, Corvallis School District), Mary's River Watershed Council and Oregon State University.

**PIP Elements**

The following is a description of the major PIP elements:

- **Designate an ESA contact for the City.** Greg Gescher, Corvallis Public Works Department Capital Planning and Projects Supervisor, was designated as the primary contact for citizen inquiries and involvement for the project. Mr. Gescher acted as the single contact person for questions regarding project progress. When needed he would contact other project team members to answer questions. His name and contact information (telephone and e-mail address) was included on all media releases, fact sheets and newsletters, and on the project website.

- **Establish an ESA response plan website.** A dedicated website was developed to provide Internet access to project information. The website was accessible directly or through a link from the City's own website. Information posted on the website included project background, schedules of public meetings and events, public meeting and activity results (summaries), project reports and technical memoranda. The website also included background information on the ESA, Section 4(d) Rules, listed Chinook salmon, and other relevant information. In addition, two public comment forms were posted on the website in order to collect public input from community members who were unable to attend the public meetings. The website was updated regularly to incorporate new information.

- **Publish articles in *The City* newsletter and other organizations' newsletters.** Articles were published in *The City* newsletter and other local publications on a regular basis to inform Corvallis citizens of the City's plans to prepare a response strategy, as well as to announce updates about the process. The newsletter was perhaps the most effective element in the media effort because it was sent to all residential households and businesses (more than 29,000 households in Corvallis). The first informational article was printed in the January 2001 newsletter. Updates were published at least quarterly and sometimes more frequently.

- **Involve other media.** Regular updates and advisories were sent to other media including the Corvallis *Gazette-Times*, Oregon State University student newspaper (The Barometer), Mary's River Watershed Council newsletter, and Corvallis Chamber of Commerce newsletter.

- **Stakeholder involvement.** Stakeholders with specific issues regarding the ESA project were identified and contacted at the beginning of the project and periodically during the project. Early involvement of informed constituent groups through a series of meetings helped to advise and refine the project, and the approach to public involvement. Hot button issues were identified early in the project, which helped the project team structure its response. Both the land use/environmental and business groups recommended strong, early, and frequent public education and involvement in the process to obtain citizen input and avoid "surprises". Both groups offered to co-sponsor events, help distribute information about the process, and encourage the active involvement of their members. Stakeholders were again contacted early in Phase II of the project, and a series of meetings were held to provide them with an update on the Phase I findings and to identify any additional project issues or concerns.

- **Public meetings and events.** Four public meetings/open houses were held over the life of the project; on May 29, 2001; February 21, 2002; November 19, 2002; and June 4, 2003. The structure of these events allowed the public to view progress and talk with the project team members in an informal format. Maps, graphs and photographs were displayed. Project team members were available to explain the work and answer questions. Handouts that attendees could take with them also were available. These events included formal presentations, question and answer periods, and "table discussions" where those attending were able to address specific topics and the project team obtained public response and input. Comment forms were always available for the public to provide additional written information. Summaries of all public meetings/open houses, along with photographs and handouts, were posted on the project website.

- **Exhibits at summer affairs and events.** In order to disseminate information about the project and to provide general information on the ESA and how citizens can be involved, the project team attended City summer affairs and events, provided information tables, distributed fact sheets and answered questions. The events attended by the project team included DaVinci Days and the County Fair.

## Phase II Pubic Involvement Plan Modifications

Prior to initiation of Phase II of the project (preparation of the solution program and report preparation), the project team reviewed the PIP and accomplishments to date with the purpose of identifying any modifications or changes in the program to make the PIP more effective. Several changes were identified and are described below.

- **Comment forms.** While comment forms had been used extensively at the public meetings/open houses, and distributed to the Chamber of Commerce and Environmental Center for distribution to the public, there was a concern that this distribution was not broad enough. It was decided that comments forms should be posted on the project website as another source for public input. Comment forms were posted to the website twice: immediately after the November 19, 2002 and June 4, 2003 public meetings/open houses.

- **Solution Options.** The project team recognized that the solution options to be developed in Phase II would be complex and not easily understood by the public, especially in their technical form. Since public input on the solution options would be very important, it was decided that non-technical versions would be prepared for public review. These versions would incorporate all the information about the solution options, but would limit the amount of technical language so the public would be more likely to understand the options.

- **PowerPoint Presentations.** Presentations at the public meetings during Phase II usually made heavy use of flip charts. The flip charts could not easily be posted on the website. It was decided that presentations at public meetings would be prepared and presented using Microsoft PowerPoint software. Such presentations could then easily be posted on the website as part of the meeting summary materials.

## Public Involvement Activities

The following is a table (Table 6) of key public involvement activities during the project.

**Table 6. Key Public Involvement Dates and Activities**

| Date | Activity Type | Description |
|---|---|---|
| October 2000 | Stakeholder Meetings | Two meetings held over two days to elicit project "hot button" issues and concern. Recorded comments, which were used to help modify the public involvement strategy. |
| January 2001 | *The City* Newsletter Article | Article describing ESA project and project schedule |
| January 2001 | Launch Website | A project-related website was developed to provide 24-hour access to project information and related topics. |
| May 29, 2001 | Open House/Public Meeting | First public meeting to present information on the project, work done to date, schedule, and related ESA information. Recorded public meeting comments |
| June 2001 | *The City* Newsletter Article | Article updating the public on the ESA project. |
| Summer 2001 | Displays at Local Public Events | Distributed information about the project at DaVinci Days and the County Fair. |
| February 21, 2002 | Open House/Public Meeting | Second public meeting. Provided update on project. Displayed maps and provided information handouts. Discussed completion of Phase I of the project. Recorded public comments about the Phase I report and initial public input on solution options to be developed in Phase II. |
| Summer 2002 | Displays at Local Public Events | Distributed information about the project at DaVinci Days and the County Fair. |
| September 2002 | *The City* Newsletter Article | Article describing ESA Phase II project status and project schedule. |

**Table 6. Key Public Involvement Dates and Activities**

| Date | Activity Type | Description |
|---|---|---|
| October 2002 | Stakeholder Meetings | Update stakeholders on project progress. Presented solution options and recorded their comments. Revised solution options based on comments. |
| October 2002 | Project Fact Sheet | Prepared project Fact Sheet for distribution at public events and public meetings. |
| November 19, 2002 | Open House/Public Meeting | Third public meeting. Provided update on project. Displayed maps, provided information handouts, and answered public questions. Presented solution options. Conducted table discussions to listen to public opinions and comments about the range of solution options to prevent further degradation of Chinook salmon habitat. |
| November 19 to December 9, 2002 | Website Comment Form | Posted online interactive comment form on project website so public could submit comments and opinions on the range of solution options. |
| January 2003 | *The City* Newsletter Article | Article on project status and synopsis of November 19, 2002, public meeting. |
| May 2003 | Media Release | News release announcing public meeting June 4, 2003. Sent release to local news media (Gazette-Times, OSU Barometer) and community and business organizations (e.g., Mary's River Watershed Council, Chamber of Commerce). Printed announcement in *The City* Newsletter. |
| June 4, 2003 | Open House/Public Meeting | Fourth public meeting. Provided update on project. Displayed maps, provided information handouts, and answered public questions. Presented revised solution options along with costs. Conducted table discussions to gather opinions and comments about the revised solution options to prevent further degradation of Chinook salmon habitat. |

**Table 6. Key Public Involvement Dates and Activities**

| Date | Activity Type | Description |
|---|---|---|
| June 9 to July 9, 2003 | Website Comment Form | Posted online, interactive comment form on project website so public could submit comments and opinions on the revised solution options. |
| June 26, 2003 | Comment Form Announcement | Sent announcement to e-mail mailing list regarding availability of the website comment form. Encouraged recipients to fill out comment form and to forward announcement to other City residents. Forwarded copy of comment form to Mary's River Watershed Council so Council could e-mail copy of comment form to their membership. |

# CHAPTER I0. CONCLUSION

## INTRODUCTION

This project has taken steps to identify and document baseline habitat conditions for chinook salmon and the options available to prevent chinook salmon habitat degradation as well as options that could actually improve such habitat and overall water quality in Corvallis streams. Many of these options have, in fact, been initiated. Through this process the City has also made a substantial effort to meet Federal compliance requirements under the Endangered Species Act (ESA), specifically with respect to the ESA Section 4(d) Rule.

These accomplishments are part of an overall process that the City has initiated to meet its goals and comply with federal requirements. What are the next steps that the City should take to continue this process and ensure success? To outline these next steps it is important to first briefly review of what has been accomplished. Based on these accomplishments a number of key steps can be identified that will ensure Corvallis will meet its goals.

## ACCOMPLISHEMENTS

The City of Corvallis initiated the Salmon Response Plan project soon after the federal government designated chinook salmon as a threatened species under the ESA (March 1999). At that time, the range for the Upper Willamette River Spring Chinook Salmon evolutionary significant unit (ESU) was identified by NOAA Fisheries (see Figure 1 in Chapter 1). Corvallis was within the ESU and therefore subject to the ESA and potential federal actions should they be accused of activities that resulted in a take of chinook salmon within their jurisdiction.

In keeping with the City's progressive attitude toward maintaining a high quality of life, which included support and protection of its natural resource base, as well as its fiduciary responsibility to protect its residents through responsible decision-making and actions, the City initiated in Fall 2000 its Salmon Response Plan Project. This was a multi-faceted approach to comply with the federal requirements. It incorporated the best scientific methodologies available to understand chinook salmon habitat with public policy development that relied on the science to ensure that activities the city would initiate had the greatest probability of success.

Through the past three and one-half years much was accomplished that sets the stage to meet its goals. The Project Team included project management from the Public Works Department Staff, a Technical Advisory Committee of City and Benton County staff, and a consultant team to provide needed expertise in biology, planning and policy, civil engineering, geographic information systems, and public involvement. In addition, the Project Team initiated a public involvement effort to provide information and seek guidance and take comment from the public (stakeholders as well as the public at large).

The results of this effort are briefly described in the following bullets.

- Scientific understanding of existing conditions: a scientifically based evaluation has been conducted that provides the City with detailed and comprehensive picture of chinook salmon habitat and water quality in the city as well as the unincorporated urban growth boundary. The scientific approach was approved and, in fact, lauded by NOAA Fisheries, the federal agency responsible for reviewing all compliance plans for the ESA Section 4(d) Rule. An extensive database was prepared on the existing habitat conditions based upon field data collection and evaluation of existing documentation (sources included the Corvallis, OSU, state and federal natural resource agencies). The database provided information on a reach-by-reach basis for all streams that could support chinook salmon habitat in the project area.

- Pathways database: The potential relationship between city activities, citizen behavior and their impact on chinook salmon habitat were analyzed. Public services provided by the city the Corvallis (e.g., public utilities, community planning, land development, transportation, parks and recreation, etc.) and citizen behaviors (e.g., yard maintenance, vegetation, vehicle maintenance, etc.) were evaluated as to their impact on the habitat. A database identifying specific city activities and their relationship to chinook salmon habitat (negative, neutral, or beneficial relationship) was prepared. Similarly, a list of citizen behaviors was prepared that noted whether such activity had a potential negative, neutral, or beneficial relationship on the habitat.

- Phase I Report: The first phase of the project ended with preparation of a report on the City's existing or baseline habitat conditions and the pathways analysis (see Appendix 6). This was submitted to NOAA Fisheries after public input from stakeholders and city residents in special stakeholder meetings and a public workshop. NOAA Fisheries review and response was positive. In a letter to the City (January 7, 2002) they approved the baseline conditions evaluation and pathways analysis and considered it a "thorough compilation of existing and new data" and the pathways analysis showing "the list of activities and potential for impact to fish and habitat appears thorough and thoughtful." Most importantly, the letter stated that "the approach and the baseline data collected will be sufficient for us to determine the technical adequacy of the final 4(d) submittal" (see Appendix 7 for copy of letter).

- Pathways Weighted Database: A comprehensive database that combined the existing/baseline conditions data with the pathways evaluation data was prepared in the second phase of the project. This was a significant development and important tool for the project because it identified the potential impacts (negative, neutral, or positive) that City activities and citizen behaviors had on chinook salmon habitat on a stream reach by reach basis. That is, it was possible to determine specifically where (i.e., what stream reach or reaches) and to what extent (negative, neutral, positive) a particular activity had on chinook salmon habitat and water quality in the stream reach(es) (see Appendix 5 for a CD of the database). In addition, the analysis incorporated a weighting factor that accounted for an activity's geographic location within or outside of the 400' stream corridor evaluation area (200-feet upland each side of the stream bank). Activities or citizen behaviors occurring within the corridor were considered to have a greater impact on chinook salmon habitat than those same activities or citizen behaviors occurring outside the corridor. Due to the number of City activity/stream reach combinations the size of the Pathways Weighted Database included over 3,500 records.

- Potential 4(d) Rule Options: By using the Pathways Weighted Database as an analytic tool it was possible to determine the geographic distribution and impact of city activities. By studying this database it was possible to determine which activities had the greatest negative impact and therefore potentially the greatest need to address through public policies. The project team evaluated the activities and identified an initial set of potential 4(d) Rule Options that could help prevent chinook salmon habitat degradation and improve water quality in Corvallis streams. The options were categorized by city activity (e.g., stormwater, parks and recreation, transportation, etc.). Some of the options identified had already or were about to be implemented by City agencies (e.g., stormwater master plan activities, Taylor pump station fish screen installation, etc.). They were still included in the list of options because they would help meet the City's ESA goals and ESA 4(d)Rule objectives. The options were presented to the public twice in public workshops to obtain public comment that would help the City refine the options and help set option priorities. In addition, comment forms were distributed and posted on the City's ESA web site to gain as wide a set of comments as possible (see Appendices 14 and 15 for copies of the comment forms). A final set of options was developed based on public input and project team review

- Monitoring Plan: In order to assess progress toward reducing chinook salmon habitat degradation and to meet requirements under the ESA Section 4(d) Rule, the project team prepared a comprehensive monitoring plan. The monitoring program closely followed the requirements outlined in the ESA 4(d) Rule. The monitoring plan would allow the city to assess progress toward meeting its habitat goals and compliance requirements. The plan had two components, scientific and programmatic. The programmatic component would evaluate the programs and program implementation outlined in the ESA 4(d) Rule Plan. It would focus on overall program development and implementation that will take place during the life of the plan. The scientific component addressed specific protocols for collecting field data comparing the data against a standard or metric to determine progress. Combined the monitoring plan would provide the City and NOAA Fisheries a method to track plan progress and effectiveness.

- Final Project Report: A final Salmon Response Plan Report was prepared that incorporated all the project team's work and products. This report outlined what had been accomplished and provided a strong base on which to move forward toward implementing the proposed options and preparing the ESA Section 4(d) Rule report to be submitted to NOAA Fisheries for compliance approval.

**FUTURE STEPS**

Before the City can submit its ESA 4(d) Rule plan to NOAA Fisheries there are a number of key activities that need to be addressed. The following are a list of these key activities.

- Select and Implement ESA Options: the City Council will need to formally adopt the proposed ESA 4(d) Rule options identified in this report. NOAA Fisheries requires that the ESA program be implemented to demonstrate that it is complying with the ESA 4(d) Rule. A number of the options are already being implemented as part of other programs, but there are options that cannot be implemented until they are adopted by the City Council. Once formally adopted the City will need to outline an implementation schedule and initiate implementation for those options that are note already underway.

- Initiate the Monitoring Program: The monitoring program will need to be activated to provide the feedback support necessary to assess program effectiveness.

- Land Development Code Update: the City is in the process of updating its land development code (LDC) to incorporate a number of environmentally sound programs and policies into its development standards. The Stormwater Master Plan, results of the Significant Natural Features (Goal 5) Project and the ESA Salmon Response Plan need to be incorporated into the LDC. By doing so the City can certify that relevant options have been incorporated into the land development standards.

- Comprehensive Plan Update: It will be important for the City to incorporate relevant elements into the City's comprehensive plan. A number of the identified options are related to city planning policies and zoning. While comprehensive planning revisions do not have to be completed, a process should be outlined or underway that the 4(d) Rule report can identify.

- Integration of ESA Plan and data, Stormwater Master Plan, and Significant Natural Features (Goal 5) data: There are two other related projects that should be integrated with the ESA Salmon Response Plan. While they may have been initiated under different authorities, they are related because they address water quality and natural resource features that the ESA program identifies as important for preserving and improving chinook salmon habitat. While there are a number of good reasons why they should be integrated, from the ESA 4(d) Rule program standpoint integration will demonstrate to NOAA Fisheries that the City is taking a comprehensive approach, which will increase the likelihood of success.

- National Environmental Policy Act (NEPA): According to NOAA Fisheries an environmental impact analysis will need to be prepared to accompany the ESA 4(d) Rule Plan submission. It is unclear at this point whether the environmental impact analysis will have to be prepared by the submitting jurisdiction (Corvallis) or by the Federal Agency. Corvallis staff and the consultants met with NOAA Fisheries officials in late Fall 2002 and Spring 2003 to discuss the environmental documentation requirement. At that time NOAA Fisheries was considering the preparation of a programmatic environmental impact statement (EIS) that would address the ESA 4(d) Rule Limit 12 that Corvallis was to submit. NOAA Fisheries could not provide a completion date because they had not yet scheduled the EIS work. One option that NOAA Fisheries suggested was that the City could prepare the EIS on its own and submit it with the ESA 4(d) Rule. The environmental documentation would take the City some time and expense to prepare. As of the date of this report, the City has not decided whether they will prepare it.

- Prepare ESA 4(d) Report: Once the above key steps are completed the City will need to submit the ESA 4(d) Rule Report to NOAA Fisheries. The report must address how the City's program will meet each of the 12 limits outlined in the ESA 4(d) Rule Limit 12 (Municipal Commercial Residential Industrial or MRCI) development program. It will be important to demonstrate that all the programs combined satisfy all the Limit 12 limits.

These are the key future steps that will need to be taken to meet the City's goals and comply with the ESA 4(d) Rule. They will build on the foundation that has been prepared up to this point.

## LIST OF ABBREVIATIONS AND DEFINITIONS

**Adaptive Management**: a type of natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and the needs of society. Results are used to modify management policy, strategies and practices.

**Anoxia**: Lack of oxygen

**DSL**: Oregon Department of State Lands

**Ecoregion**: An area over which the climate is sufficiently uniform to permit development of similar ecosystems on sites that have similar properties. Ecoregions contain many landscapes with different spatial patterns of ecosystems.

**EFH**: Essential Fish Habitat. Congress defines EFH as "those waters and substrate necessary to [all Federally Managed] fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802(10)). In Section 303(a)(7) of the amended Magnuson-Stevens Act, Congress directs the National Marine Fisheries Service (NMFS) and the eight regional Fishery Management Councils, under the authority of the Secretary of Commerce, to 1) Describe EFH and identify EFH in each fishery management plan, 2) Minimize to the extent practicable the adverse effects of fishing on EFH, and, 3) Identify other actions to encourage the conservation and enhancement of EFH. The mandate also includes the development of conservation and enhancement activities for non-fishing related adverse impacts to designated EFH areas. Review of impacts and recommendation for conservation and enhancement of EFH is typically integrated into the existing environmental review procedures in accordance with the National Environmental Policy Act, Endangered Species Act, or Fish and Wildlife Coordination Act. While state and local actions that may adversely affect EFH do not require consultation under the Magnuson-Stevens Act, NMFS must provide Conservation Recommendations for these actions that would adversely affect EFH, if NMFS becomes aware of such actions. However, where proposed state and local actions have an impact on ESA listed anadromous fish such as Upper Willamette River Spring Chinook, NMFS has regulatory authority and therefore must review and provide conservation recommendations, unless the jurisdiction has an approved ESA Section 4(d) Rule Plan.

**Endangered Species Act**: See ESA

**ESA**: Endangered Species Act. A 1973 Federal law, amended in 1978 and 1982, to protect troubled species from extinction. The NOAA Fisheries and U.S. Fish and Wildlife Service (USFWS) decide whether to list species as threatened or endangered. Federal agencies must avoid jeopardy to and aid the recovery of listed species.

**Essential Fish Habitat**: See EFH

**ESU**: Evolutionarily Significant Unit. ESU is defined as a population that 1) is substantially and reproductively isolated from specific populations and 2) represents an important component in the evolutionary legacy of the species. Information that can be useful in determining the degree of reproductive isolation includes incidence of straying, rates of recolonization, degree of genetic differentiation, and physical or ecological barriers to migration. Insight into evolutionary significance can be provided by data on genetic and life-history characteristics, habitat differences, and the effects of stock transfers or supplementation efforts

**Eutrophication**: A process whereby a water body is becoming rich in nutrients, organic materials, and productivity.

**Evolutionarily Significant Unit**: See ESU

**Hortonian**: Overland flow of water.

**Hydrograph**: A graph that illustrates the relation of discharge, stage velocity or other water component with time, for a given point on a stream.

**Mosaic**: A pattern of vegetation across a landscape.

**National Marine Fisheries Service**: See NOAA Fisheries

**National Oceanic and Atmospheric Administration National Marine Fisheries Service**: See NOAA Fisheries

**NMFS**: see NOAA Fisheries

**NOAA Fisheries**: National Oceanic and Atmospheric Administration National Marine Fisheries Service, part of the U.S. Department of Commerce. The Administration is dedicated to protecting and preserving our nation's living marine resources through scientific research, fisheries management, enforcement, and habitat conservation, including anadromous fish. Anadromous fish are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn. Among NOAA Fisheries' duties is responsibility for enforcing the Endangered Species Act (ESA) for listed marine and anadromous species including the Upper Willamette River Spring Chinook, which are listed as threatened under the ESA.

**Oregon Department of State Lands**: See DSL

**PFC**: Properly Functioning Condition. Refers to an optimum state of aquatic habitat health as defined by the National Marine Fisheries Service. Presence of properly functioning conditions can enhance the long-term survival of anadromous salmonids. This optimum state of stream health is identified by key variables that provide the best possible environment for fish (e.g., Water temperature, Canopy cover, Sediment, Instream large wood, Large wood recruitment, Pool frequency, Pool quality).

**Properly Functioning Condition**: See PFC

**Take**: As defined in the definitions of the ESA (Section 3 (19)) means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt to engage in any such conduct.

**Top-of-bank**: Pont on a stream bank that corresponds to the high water mark for normal streamflows.

**U.S. Fish and Wildlife Service**: See USFWS

**USFWS**: U.S. Fish and Wildlife Service. The USFWS is an agency in the Department of the Interior that conserves and protects fish and wildlife and their habitats. With respect to the Endangered Species Act (ESA) the Agency along with NOAA Fisheries shares responsibility for administration of ESA. Whereas, though, NOAA Fisheries is responsible for ESA listed marine and anadromous species, USFWS is responsible for non-anadromous fish species, plants, and terrestrial wildlife.

**Weighting**: a method of rating the degree of importance of a factor or variable.

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